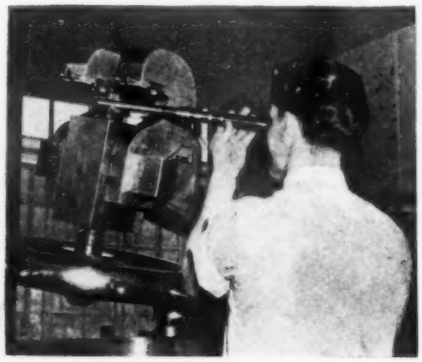
AMERICAN MACHINIST

May 15, 1940



The Shadow—*Straightness of the barrel bore is checked by a cone-shaped shadow in Canada's production of Bren machine guns*

MASON BRITTON, Vice-Chairman
FRED H. COLVIN, Editor Emeritus
BURNHAM FINNEY, Editor
KENNETH H. CONDIT, Consulting Editor
JOHN HAYDOCK, Managing Editor

S. ASHTON HAND — BEN C. BROSHEER
WILLIAM W. HORINE — WILLIAM J. HARGEST
FRANK RISING — C. G. SMITH
RUPERT LE GRAND, Detroit — RAYMOND R. WIESE, Chicago
PAUL WOOTON, Washington — CHAS. F. McREYNOLDS, Los Angeles

N. O. WYNKOOP, Publisher
W. E. KENNEDY, Manager

McGraw-Hill Publishing Company, Inc.

Publication office, 99-129 North Broadway, Albany, N. Y. Editorial and executive offices, 330 West 42nd Street, New York, N. Y. Branch offices: Chicago, 520 North Michigan Ave.; San Francisco, 68 Post Street; Aldwych House, Aldwych, London, W. C. 2; Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Atlanta.

JAMES H. McGRAW
Founder and Honorary Chairman

JAMES H. McGRAW, Jr., President — HOWARD EHRLICH, Executive Vice-President
MASON BRITTON, Vice-Chairman — B. R. PUTNAM, Treasurer
D. C. McGRAW, Secretary — J. F. BLACKBURN, Jr., Director of Circulation

VOLUME 84 — NUMBER 10

AMERICAN MACHINIST. Copyright 1940 by McGraw-Hill Publishing Co., Inc.

Published every other Wednesday, price 35c a copy. Subscription rates—United States, Canada, Mexico, and Central and South American countries, $3.00 a year. All other countries (except Europe and British possessions in Eastern Hemisphere), $6.00 a year or 36 shillings. Entered as second class matter, September 29, 1936, at Post Office, Albany, N.Y., under the act of March 3, 1879. Printed in U.S.A. Cable address "McGrawhill, New York." Member of A.B.P. Member of A.B.C.

A McGRAW-HILL PUBLICATION

PRINTED IN U.S.A.

MAJOR ARTICLES

Canada Arms Britain 317
Molded Plastics Made to Match 333
Equipment for Chucking ..*J. R. Longstreet and W. K. Bailey* 334

IDEAS FROM PRACTICAL MEN

An Improvement in Straight-Edges .....*F. L. Southwick* 338
Adapters for Lathe Chucks .....*Arthur Silvester* 338
Improvised Piercing Tools .....*Emil Wittmann* 338
Press Tools for Piercing Slots .....*Charles H. Willey* 339
A 51-in. Hole Bored on a 27-in. Lathe .....*D. L. Wheeler* 339
Indexing Milling Feature .....*John Jergens* 340
Miller Table at the Spindle Center ....*Charles Homewood* 340

NEWS OF THE INDUSTRY

Gaging Business 344b
Inside Detroit 344e
Watching Washington. 344h
Names in the News ... 344k
Plant Expansion 344l
Obituaries 344l

DEPARTMENTS

What's in This Issue .. 39
Reference Book Sheet .. 341
Editorial 344d
Shop Equipment News. 345

ADVERTISING PAGES REMOVED

A Standard of Comparison To Help You

★

These typical comments on the last Modernization Number, featuring American Machinist's 5-year Inventory of Metal-working Equipment (April, 1935), show how readers use this issue:

W. H. FLYNN, *General Superintendent*
The New York Central Railroad
New York, N. Y.

"I can assure you that the information in this inventory is not only interesting to the writer but will also be of decided value to our various shop representatives."

FRED BUCK, *President*
The Lufkin Rule Co.
Saginaw, Mich.

"We are making a survey of our own plant which will indicate many replacements and additional machinery."

S. A. COGSDILL, *President*
Cogsdill Manufacturing Co., Inc.
Detroit, Mich.

"It has enabled us to check up the condition of our own plant and I know of no other way this could have been accomplished except through the survey you have made."

J. L. LONERGAN
Morris Machine Works
Baldwinsville, N. Y.

"We are filing this issue away, as it will make splendid evidence should it be necessary to prove our point with our Directors that about 77% of our equipment according to your tabulation is proving an expensive luxury to operate."

E. J. RAVERTY, *Vice-President*
New Albany Machine Mfg. Co.
New Albany, Ind.

"The inventory is very comprehensive, and after checking over some of the figures concerning our equipment it shows we need quite a lot of new equipment, especially after looking through this copy of the American Machinist."

WATCH FOR THE MODERNIZATION ISSUE

To Serve These and Many Other Purposes

WHAT'S IN THIS ISSUE

STORY BEHIND A STORY

In this issue we crash through with a special sixteen-page section "Canada Arms Britain." It is the story, with some swell pictures, of what Canada is doing to help arm the mother country for her fight against Germany. Manufacture of the famous Bren machine gun and of 40-mm. shells is described. But what a headache and what a job it was to get the data. The trail led from New York to Washington to Ottawa to Toronto and to way points.

The first man contacted was the Canadian minister at Washington. Certain other people in the Capitol (names deleted by our own editorial censor) went to bat for us, too Then came a visit to Ottawa in the midst of the final stages of a Dominion national election. That visit was strung over three days. It included talks with officials in the Prime Minister's office, with the War Supply Board, with the Department of Public Information, with high Canadian army officers. But finally a favorable decision was given after much eloquent oratory.

Then came the job of gathering the material by going into Canadian munitions plants and also of taking pictures. That was a Lulu, because every time you turned around somebody told you why you couldn't get what you were after. But every occasion has its hero, and this time the hero was none other than our substantially upholstered Detroit editor Rupert LeGrand, who labored about 20 hours a day for ten days, and came through with flying colors.

CRITICAL COLOR

Imagine seven pieces of translucent plastic, made of three different formulas, which match perfectly when assembled! Not an impossible job, you might say, but not a practical one on a mass-production basis. No? That's just the way the instrument panels for the 1940 Chryslers are made. Accurate control of every step of the process makes it possible. The set-up is discussed on page 333.

MINIMUM

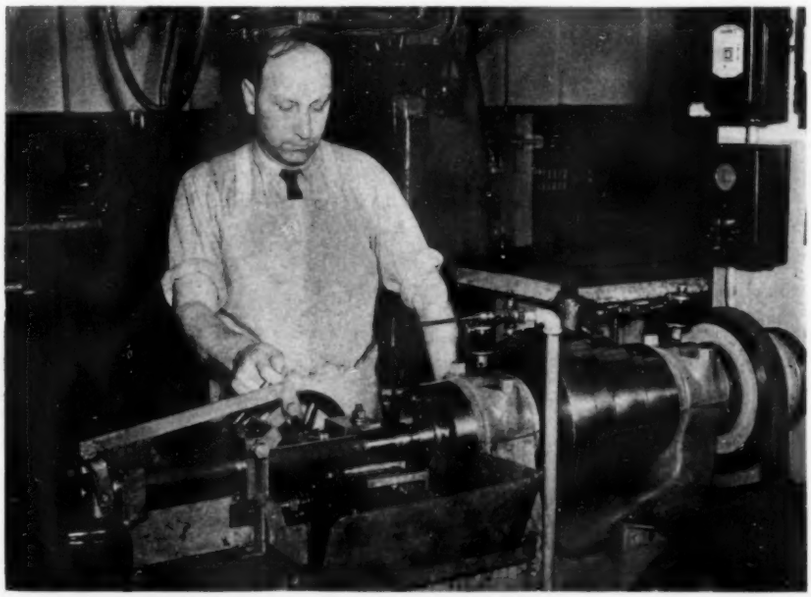
Just how much tooling is needed for the average turret lathe? J. R. Longstreet and W. K. Bailey, of Warner & Swasey, say that universal tooling equipment for chucking work represents about the smallest amount of tooling that should be available. That is only half the story, however. They elaborate on the principle of the permanent set-up and give many concrete examples of actual work. This information, and much more, is contained in installment seven of their series on "Turret Lathe Tooling," which begins on page 334.

STOCK ANSWER

In line with turret lathe operation are the Reference Book Sheets on pages 341 and 343. These handy charts permit calculating weight of bar stock for 1,000 pieces, given the diameter and length of one piece, simply by laying a ruler across a couple of scales. Both brass and steel, in round and hex forms, are included.

WHAT'S NEW?

We are constantly reminded by the editor who conducts the "Shop Equipment News" section that his department is the best-read in the book. We can understand why, too. The endless procession of equipment designed to save time or do a better job never fails to impress us. Everything from lock washers to gigantic presses parades through the section, which begins this time on page 345. Whether you're interested in the most elaborate equipment or the most ingenious in gadgets you'll find it in this department.

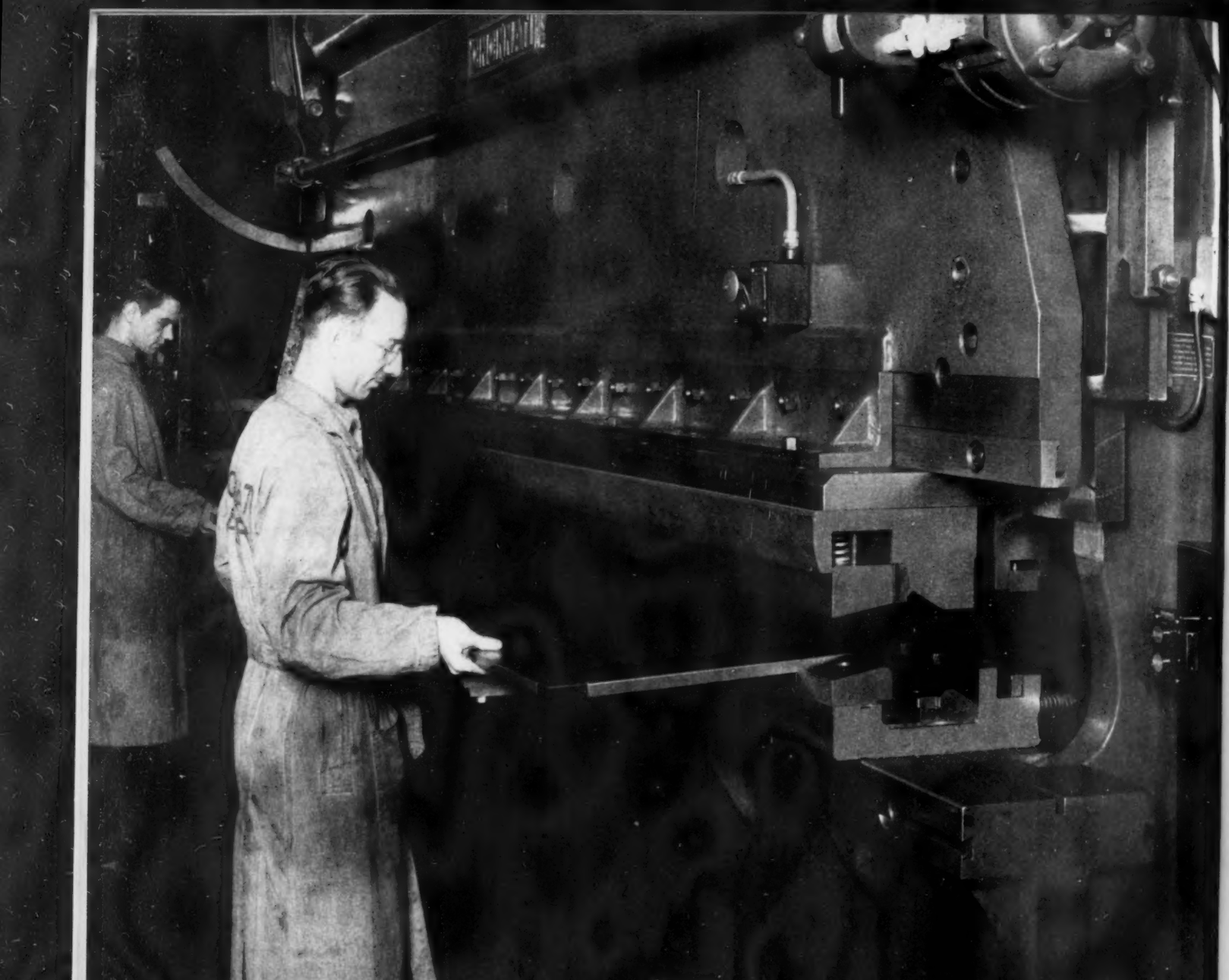


Doing His Bit—*Helping Canada arm Britain, as detailed in the article beginning on the following page, is this operator of a special-purpose machine developed to increase production of 40-mm. shells. It produces "waves" on the shell bodies for retension of the copper driving bands*

COMING

As you might suspect, we of the staff are frantically completing the 1940 inventory of machine tool obsolescence in the metal-working industry. Most of the issue of May 29 will be devoted to the subject, which we feel is one of the most important ever to come within our province.

Old subscribers will recognize the inventory as a recurrent feature. Started in 1925 and repeated every five years, it has provided an accurate, detailed check on machine tool buying habits, trends and markets. In the inventory the country's metal products are broken down into twenty classifications, and the obsolescence situation analyzed not only from a country-as-a-whole standpoint but also by geographical divisions. The results are tabulated and defined for ready reference, and are interpreted in the light of past inventories and studied judgment. All this, and more, too, in the issue you can't afford to miss—the May 29 AMERICAN MACHINIST.



Refrigerator manufacturers find Cincinnati Press Brakes cost less to own because they accurately punch, notch and form the top and two sides of a refrigerator cabinet from a single sheet.

Write for recommendations on your job.

GIBSON REFRIGERATOR CORP. PHOTO

THE CINCINNATI SHAPER COMPANY, CINCINNATI, OHIO

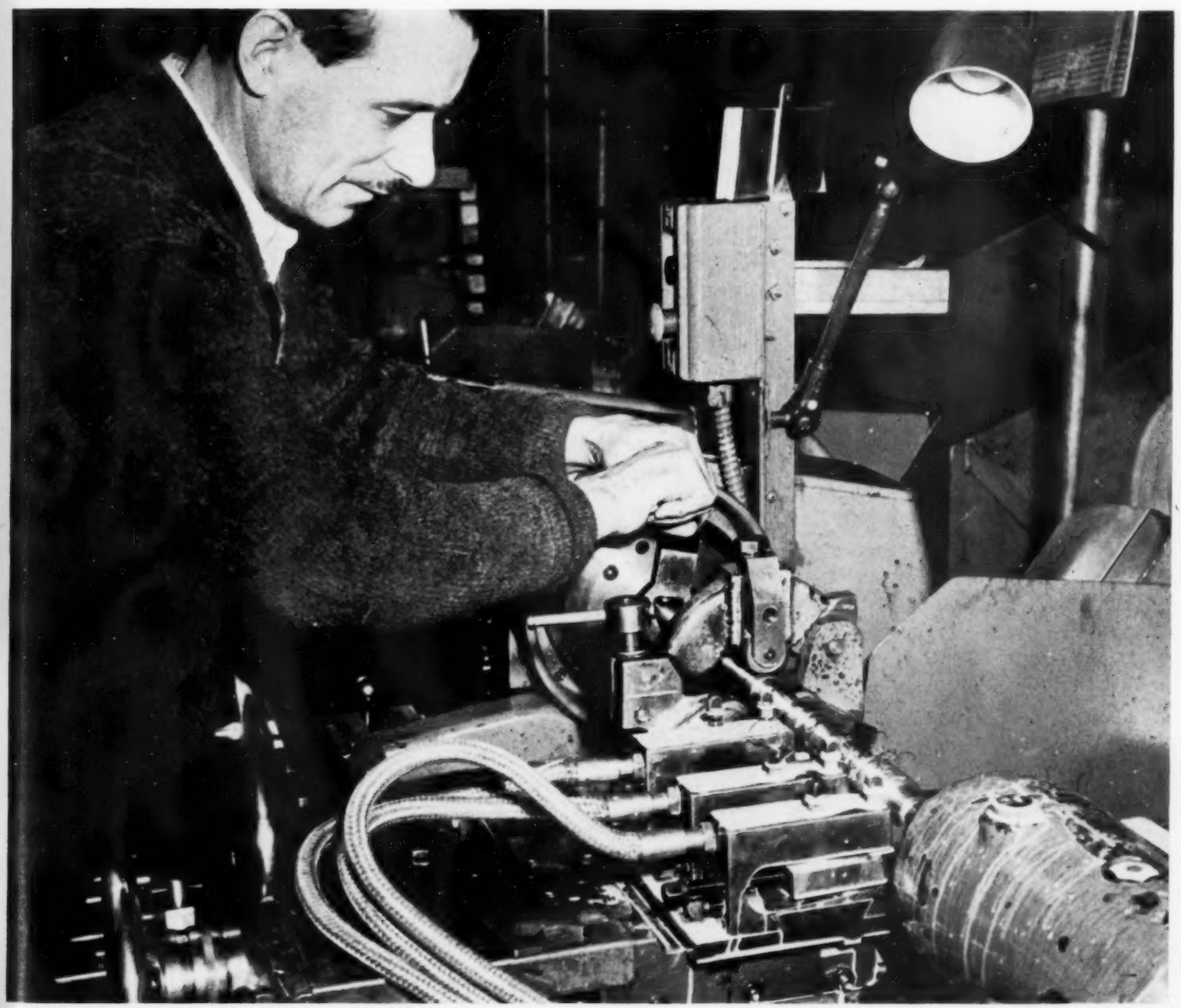
SHAPERS · SHEARS · BRAKES

ESTABLISHED 1877 **AMERICAN MACHINIST** BURNHAM FINNEY, Editor

CANADA
PASSED BY THE
PRESS CENSORS

CANADA ARMS BRITAIN

CANADIAN INDUSTRY HAS ANSWERED THE CALL TO ARMS BY TURNING PEACE-TIME PLANTS TO MUNITIONS PRODUCTION. OUTSTANDING EXAMPLES ARE THE SHOPS MAKING THE BREN MACHINE GUN AND THE 40-MM. SHELL



As World War II spreads

and intensifies, more munitions and more aircraft will be needed. Alive to that fact, the Allies are counting heavily on Canadian support. The Dominion already is on its way to becoming the western arsenal for Britain and France. Munitions orders totaling $70,000,000 have been placed in Canada, and $17,000,000 more will be awarded soon.

To show that the Canadian government has been pushing actively the manufacture of munitions and has been educating industry in the technique of ordnance production, AMERICAN MACHINIST takes you on this page and on the succeeding 15 pages into two Canadian plants. One is the factory where the famous Bren machine gun is built.

AMERICAN MACHINIST is the first U. S. metal-working paper whose editors and photographers have been permitted to enter Canadian munitions factories and describe manufacturing operations.

Guns ahead of schedule

PRODUCTION of the first Canadian-made Bren gun five months ahead of schedule, marked fruition of plans to establish machine gun manufacture in the Dominion. No one had built machine guns in Canada before, and few Canadian mechanics had any knowledge of the gun-making art. The letting of a contract for Bren guns to a Canadian plant was largely a matter of faith in the organizing ability and technical skill of its officers.

There were good reasons why military planning boards had estimated that it would take at least two and a half years to set up production of the Bren in Canada. While it was true that the experience of a British plant could be drawn upon, it was necessary to bring together a large number of precision machine tools, to make thousands of tools, gages and fixtures, and to revise British tool drawings where deemed advisable, in order to suit the equipment obtainable for the Canadian plant. In addition it was necessary to recruit highly skilled men for tool-making activities, to hire first-class mechanics for the production department and to acquaint the personnel with gun making.

The first Canadian-made Bren gun was produced in less than two years from the date when three plant officials sailed to England for the purpose of familiarizing themselves with the methods used in the British plant for Bren production and with the gun-making art as a whole. Upon return two and a half months later, the company made plans to secure 600 machine tools, to make or buy 17,604 fixtures, tools and gages, and to bring together and train a supervisory and production force.

One of the first steps was to write specifications for equipment and secure approval from authorities at Ottawa. This procedure was necessary because all equipment used in the production of Bren guns is the property of the government, the manufacturer operating on a cost-plus basis. All machine tools were tested to close standards of accuracy and performance, before acceptance.

To England for Training

While awaiting delivery of equipment, the company hired foremen and specialists and sent them to England for training at the British plant. Toolroom activities got under way first because of the immense job of building thousands of accurate fixtures, tools and gages to the precision standards involved in gun work.

There are plenty of toolmakers in the Dominion, but the gun factory needed men accustomed to working a ten-thousandth of an inch. By scouring all parts of Canada, the company was fortunate to secure 100 men who would be a credit to any toolroom. Incidentally it is a requirement that all persons connected with Bren machine gun manufacture must be British subjects.

Expert tool designers, time-study men, and set-up men were brought in as the first production machines began to arrive in July, 1939. From then on the training of machine operators became a major problem. These people had experience in handling machine tools, but not in connection with the precision required for machine guns. But by March, 1940, some 500 operators and inspectors were functioning well enough so that good sized batches of finished parts were meeting the critical examination of independent government inspectors. Several women are on the factory payroll and are being shifted from job to job. With experience they will be able to break in others if the men are called to the colors.

The Bren gun is made entirely from Canadian materials except for the walnut stock. Fifteen special alloy steels are produced in Dominion plants under exacting government control. Thus, the Bren contract is serving to educate Canadian plants and personnel with the production of war material. The experience so gained should stand the Empire in good stead as Canada expands output of war goods, and the technical skill acquired will prove of material benefit when peace returns.

The difference between commercial production and machine-gun manufacture is typified by one of ten periodic inspections used on the Bren machine gun body. Laid out above the bench are 80 distinct gages that must be used in this single periodic check; the body is only one of 161 parts requiring inspection

During the functioning test the inspector stands erect because he does not have to sight the gun. Another rest is used when the gun is fired for accuracy

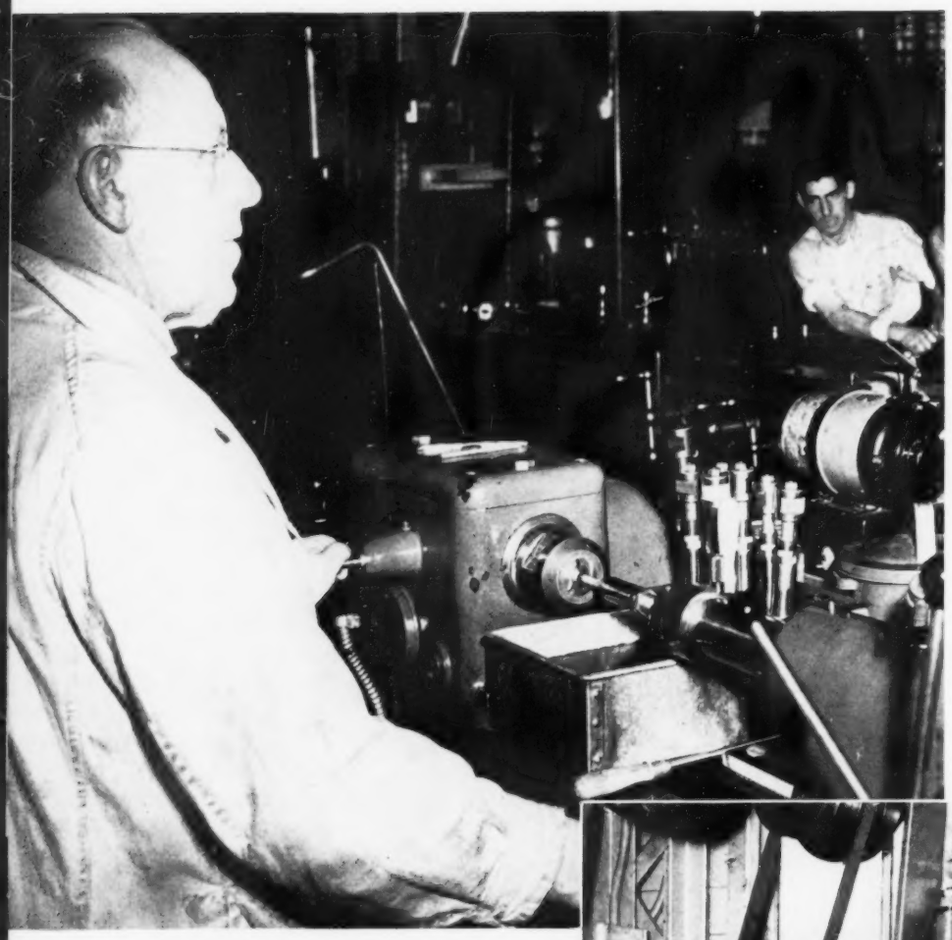
Barrels for the Bren

THE FIRING RATE of the air-cooled Bren machine gun is so high that the barrel overheats. For this reason, two or three barrels are supplied with each gun. When one barrel gets hot, it is unclamped, dropped on the ground or into water and a cool barrel is snapped in place in less time than it takes to read this sentence.

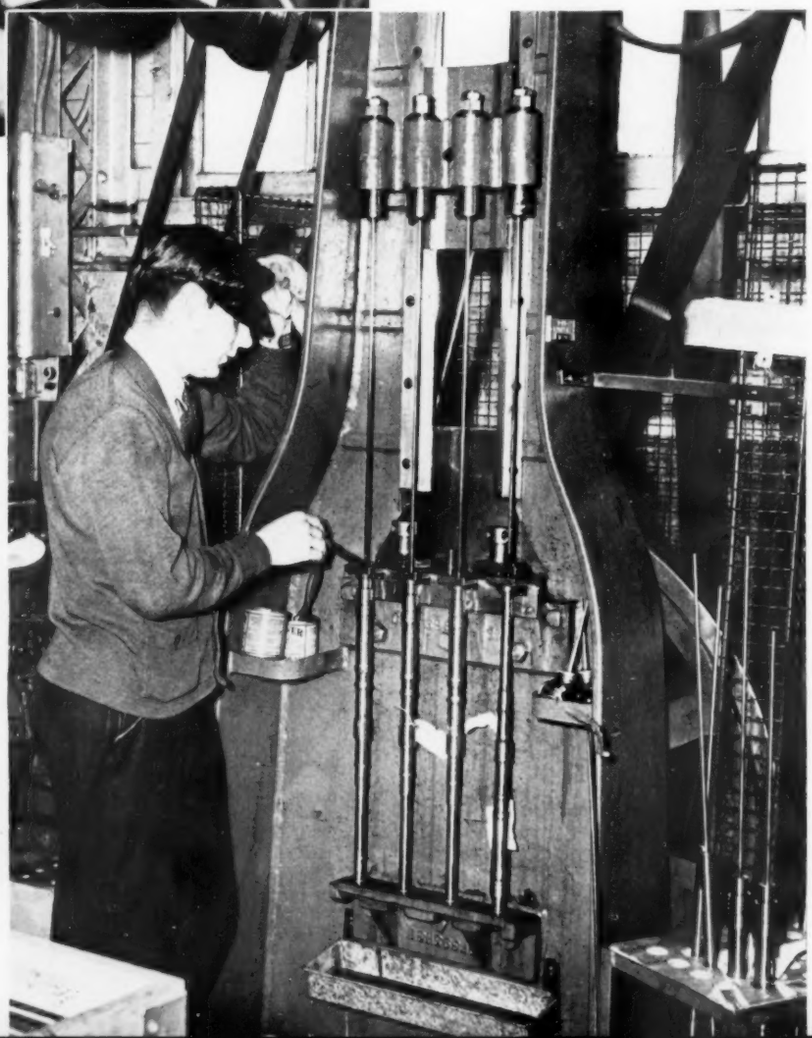
Barrels must be interchangeable and able to withstand the abuse incident to combat conditions without losing accuracy for thousands of rounds. It is said that the first Canadian Bren gun fired 8,000 shots without noticeable change in accuracy.

To meet military specifications, 80 operations are required on the barrel, including several periodic inspections on a number of vital dimensions and several straightenings. Many of the barrel operations used by the Canadian Bren plant are common practice in English and American gun plants, although some practices correspond only with methods in force at the British Bren plant.

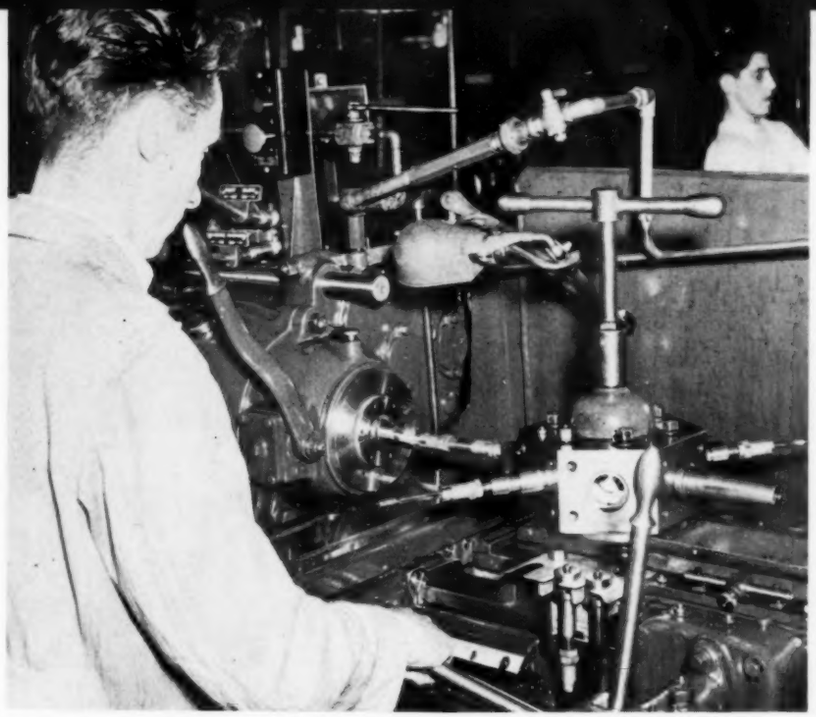
Every bar, which measures $23\frac{1}{2}$ in. long by $1\frac{3}{8}$ in. in diameter, is inspected before application of the



Eight slip reamers bring the chamber to a 100 per cent bearing with an absolute dimension gage. Practically no material is removed at any stage in finish reaming. High-carbon reamers are chosen because of their ability to retain a keen edge for long periods



For polishing the rifling, a lead draw lap is cast on a draw rod to fit the individual barrel. The draw rod is removed from the barrel and the lead lap is nicked to catch lapping compound, after which the lap is placed with its barrel in a draw lapping machine. Usually the lap is entered from the breech end, but may be reversed to polish out any blemishes discovered during the lapping process. Laps run in the barrels for about a half hour, are fed with lapping compound. Should the barrel become warm to the touch, the compound is thinned with No. 60 spindle oil. Chucks for the draw rods operate in ball bearings to permit the laps to follow the rifling freely



Roughing and semi-finishing the vital chamber in the breech are done upon a Ward turret lathe. Three slip reamers are used at the third turret position

batch number. After facing the ends and centering, barrel forgings are roughed and semi-finished on three BSA lathes that are equipped for form turning where necessary. After the first nine operations, the barrel receives its first periodic check in the inspection department. These periodic checks may involve use of a score or more gages.

After inspection, the barrel is ready for rifle drilling. This operation is done on conventional equipment, but the oil pressure to the D-bit is maintained at 1,000 lb. per sq. in. A special filtering system removes any fine particles or chips from the recirculated oil. The combination of high oil pressure and exceptionally clean oil is given credit for trouble-free rifle drilling.

Centers were lost in the drilling operation, so the ends are re-coned before reaming. Straightening follows by the shadow method imported from the British plant. The barrel is held to the eye and pointed at the north sky just below the overhead black canopy. A cone-shaped shadow will be seen in the bottom of the barrel. After six months training the operator becomes proficient in judging where the barrel is out of true by the irregularities in the shadow, and is able to turn out more straightened work per hour than by other methods.

At this point it is desirable to perform a number of operations on the barrel exterior because they have a tendency to distort it. To avoid inaccuracies, the barrel is straightened, re-coned and reamed three times before finishing the bore.

Bore-finishing includes practices used at the British plant. "Spill boring", or pack reaming, is an example. A long tool with two flat sides and two parabolic sides roughly approximating a square is backed up by a spill of wood. The two cutting edges are placed 180 deg. apart, but only one of them scrapes the bore as the tool is fed into the barrel. The spill bore is ground by hand on a grindstone and its cutting edges are not true straight edges. Practically no material is removed in the process, but it does produce a highly polished straight hole.

Rifling is done by conventional methods. To lap the rifling, the Canadian Bren plant has developed a vertical draw lap that does four barrels at once. The lead lap for the rifling is cast to the individual barrel, but the cylinder lap for polishing the lands is not.

Last stage in production of the barrel is chambering. Gun makers regard chambering as an art. It is necessary to produce the chamber to 21 "star" dimensions, there being no allowable limit on any part of the chamber. The plug gage must show 100 per cent bearing at the point checked. So-called roughing is done on a Ward turret lathe, six tools being used. Finishing is done on a Holroyd reaming machine, as many as nine reamers being employed in sequence to scrape infinitesmal amounts of metal from various points in the chamber. The reamers float and are of the slip type for ready interchangeability upon the reaming machine.

A final straightening by the shadow method and 100 per cent inspection must precede turning over the barrel to government inspectors. An Army officer and his staff check barrels during various stages in manufacture and make rejections on anything which does not meet with their approval. Dimensional accuracy, finish, how surfaces are blended, and freedom from scratches are among the points checked by the government.

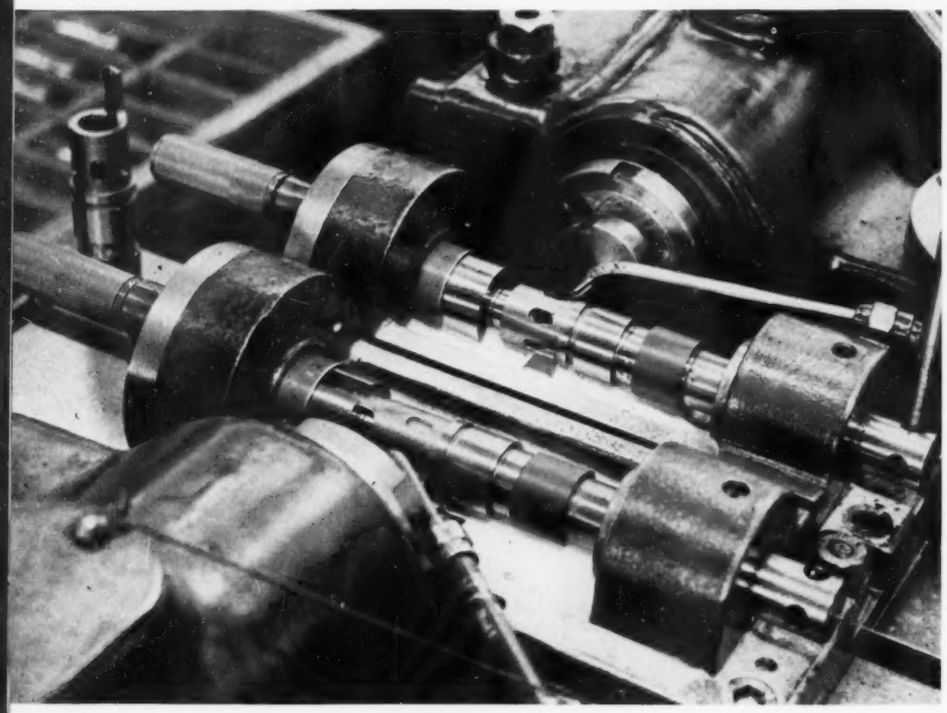
Parts made by milling

RAW STEEL required for each Bren gun weighs 101 lb., but the finished parts weigh only 18 lb. Thus 83 per cent of the original metal is converted into chips; and most of these chips are made by milling cutters.

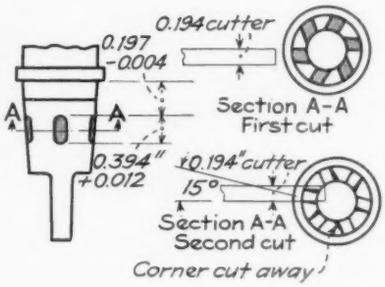
Milling machines are needed for the larger share of the 2846 operations on each gun, because of their versatility in handling cuts. Even the barrel is rotary milled. In fact, almost every type of milling operation is called for in the manufacture of the varied parts of the Bren machine gun.

So much dependence is placed upon milling that 350 out of 500 machine tools used in production are the latest-pattern English, American and Canadian millers of diverse types. Some of these machines are permanently set up, but the majority must be adaptable to the quick changes required in batch manufacture of 161 parts.

In buying milling machines, the management attempted to obtain equipment with a minimum number of motions and slides. It was believed



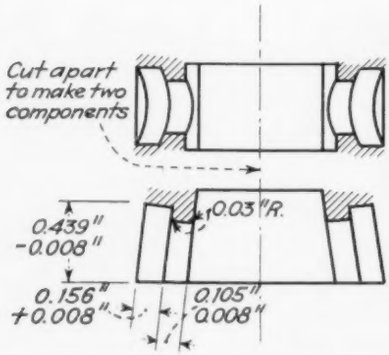
Six elongated holes around the periphery of the gas cylinder are spline milled on an Asquith machine. Infeed of the cutter spindles is controlled by cams, sixteen cycles a minute. After the cutters are fed 0.0048 in. at each stroke, the table is traversed by a crank feed that can be varied between 4.7 and 36 in. per min. Cutter speed is 1,000 r.p.m. in this set-up. Slots are milled straight through in one fixture, then the gas cylinder is relocated in a second fixture to mill one inner edge of the elongated hole



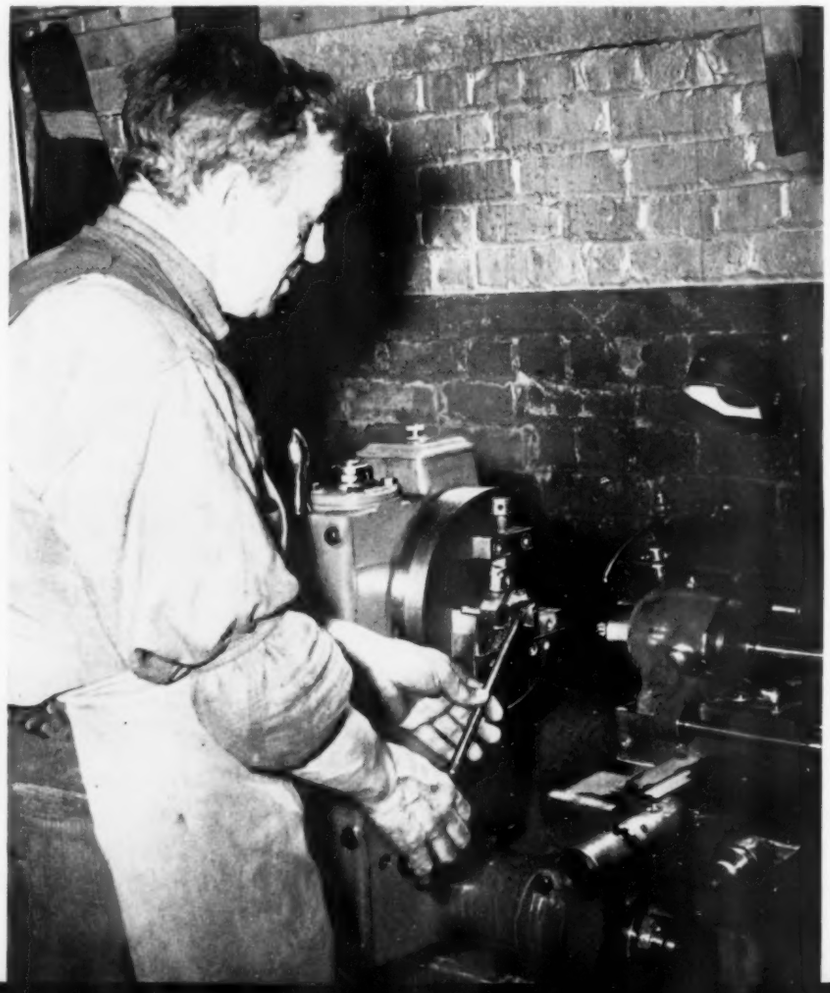
that many millers are essentially toolroom types, with an excess of motions, slides, speeds and feeds for simple production set-ups. These features were suspected of being probable sources of trouble in close work on hardened steel. Finish is just as important as dimensional accuracy in machine-gun work, because cuts must be blended without noticeable variation in surface quality.

The management's desire to obtain equipment with a solid bed and table construction is credited with furthering development of the production-type automatic rise and fall milling machine. In gun work, it is often necessary to mill behind an obstruc-

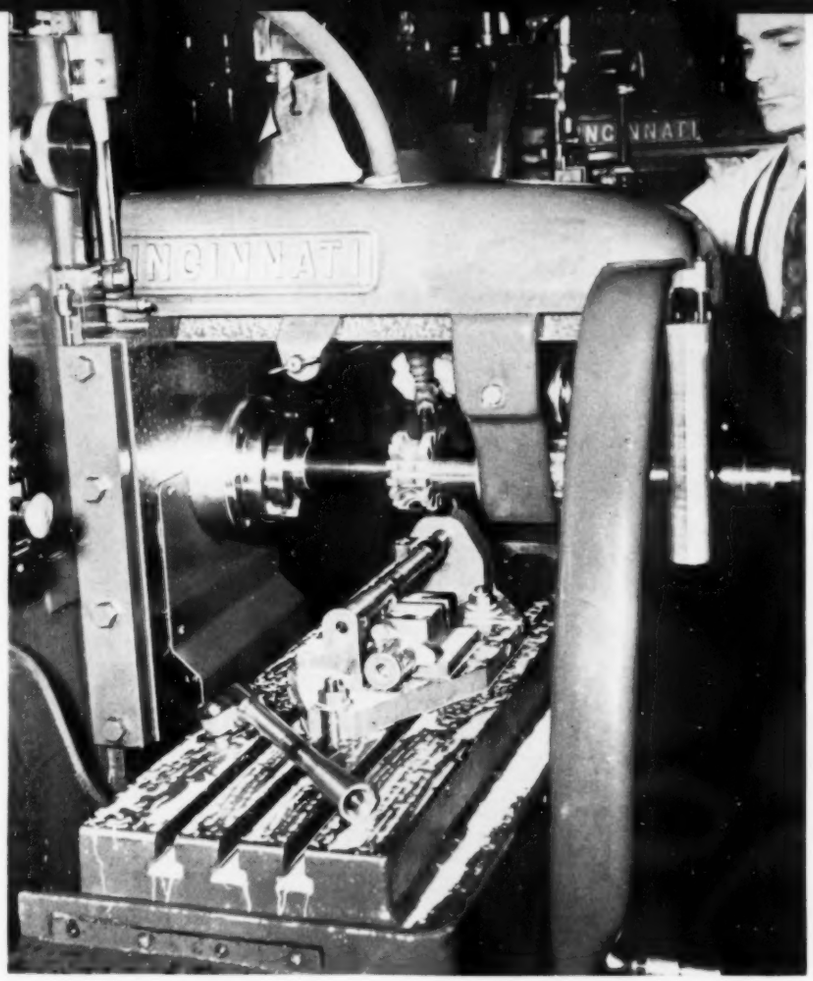
(Continued on page 324)

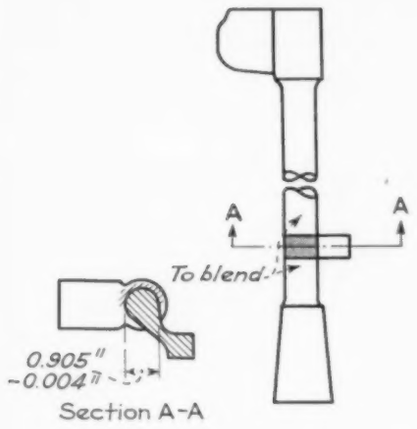


Two extractors are rotary milled at once to avoid holding difficulties, and are sawed apart at a later operation



Rotary milling the groove and rounded end on the extractor is done on a Coventry machine fitted with a roughing and a finishing spindle. Practically no clearance is allowed in the work-head fixture, so the piece must be pried out with a screwdriver

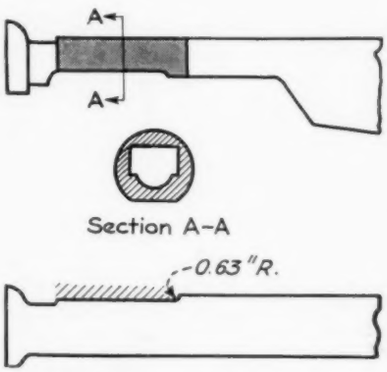




Rise and fall milling on a Cincinnati avoids the difficulties attendent to using a knee-type machine on work where end obstructions will not permit the table to be traversed directly to the cut. The automatic cycle of this machine permits relatively unskilled operators to mill the part without damage. Time per piece, 3¼ min. Form turning of the sleeve barrel is interrupted by the lug. To blend the two contours shown requires a machine with a solid table and bed construction, in the opinion of the gun manufacturer. Hence, a rise and fall miller was selected for the operation

Another rise and fall milling operation is involved on the machine gun body. This part requires literally hundreds of precision operations. The job of milling a highly finished and accurate pad just beyond an obstruction at the end of the body is credited with hastening development of the rise and fall milling machine

Milling the pad on the body is done at a spindle speed of 254 r.p.m. and a table feed of 1¾ in. per min.

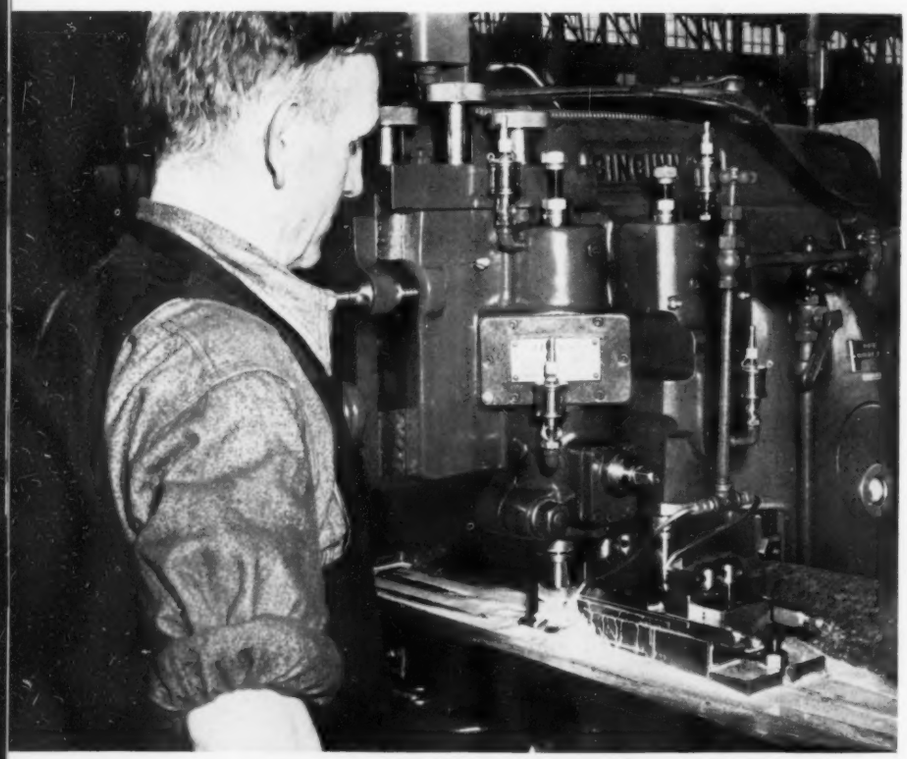


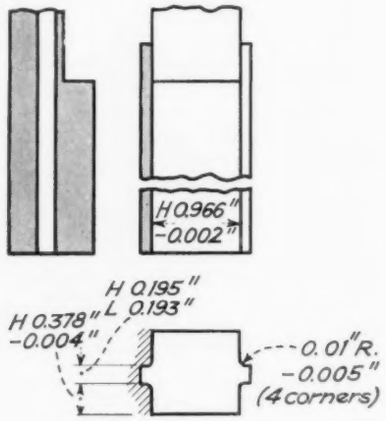
tion. Knee-type machines were criticized on several grounds: (1) that knee-type construction is not sufficiently rigid for gun work, (2) there is danger of running the cutter into the piece and running a part upon which perhaps scores of costly operations have already been performed, (3) operation of the knee-type miller is too slow for production purposes. With a rise and fall miller, having an automatic cycle, the operator need know only how to put the piece in the fixture correctly and to push the starting button. Women can run such machines if the necessity arises.

English milling machines were given preference. It was desired to duplicate set-ups at the British plant, which has had several years of experience in making the Bren gun. Furthermore, English machines are considerably cheaper in Canada; their simplified construction is well adapted to gun work. Special features that enhance production are seldom needed because of the length of cutting time.

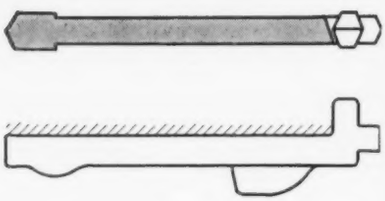
Fifteen types of steel are milled, most of them heat-treated to maximum physical properties consistent with use and good machining. The general practice is to specify a cutting speed of 80 ft. per min. and a feed of 0.002 in. per tooth. On some jobs the speed is raised to 105 ft. per min., particularly where the heat conductivity is good.

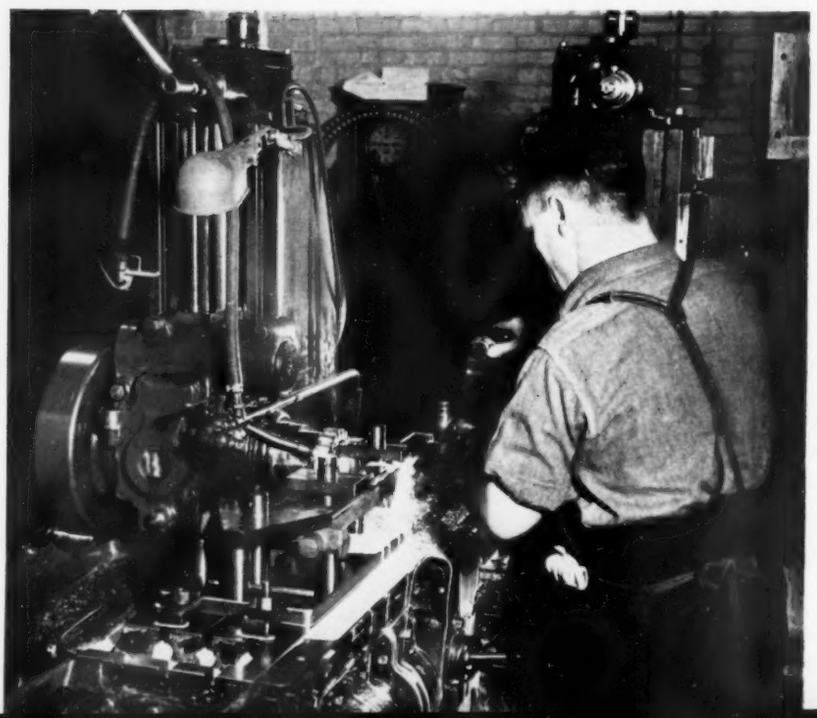
The illustrations show selected examples of the type of unusual operation met in machine-gun manufacture. For every unusual operation there are a score of the ordinary variety.



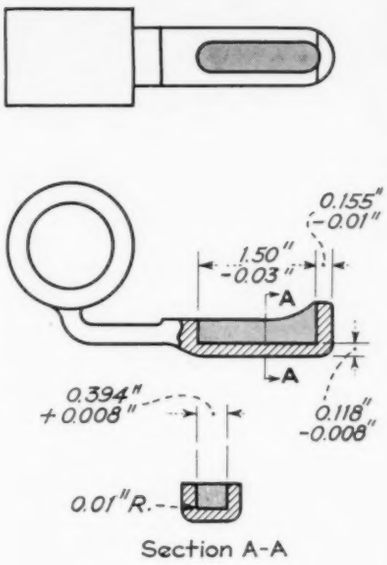


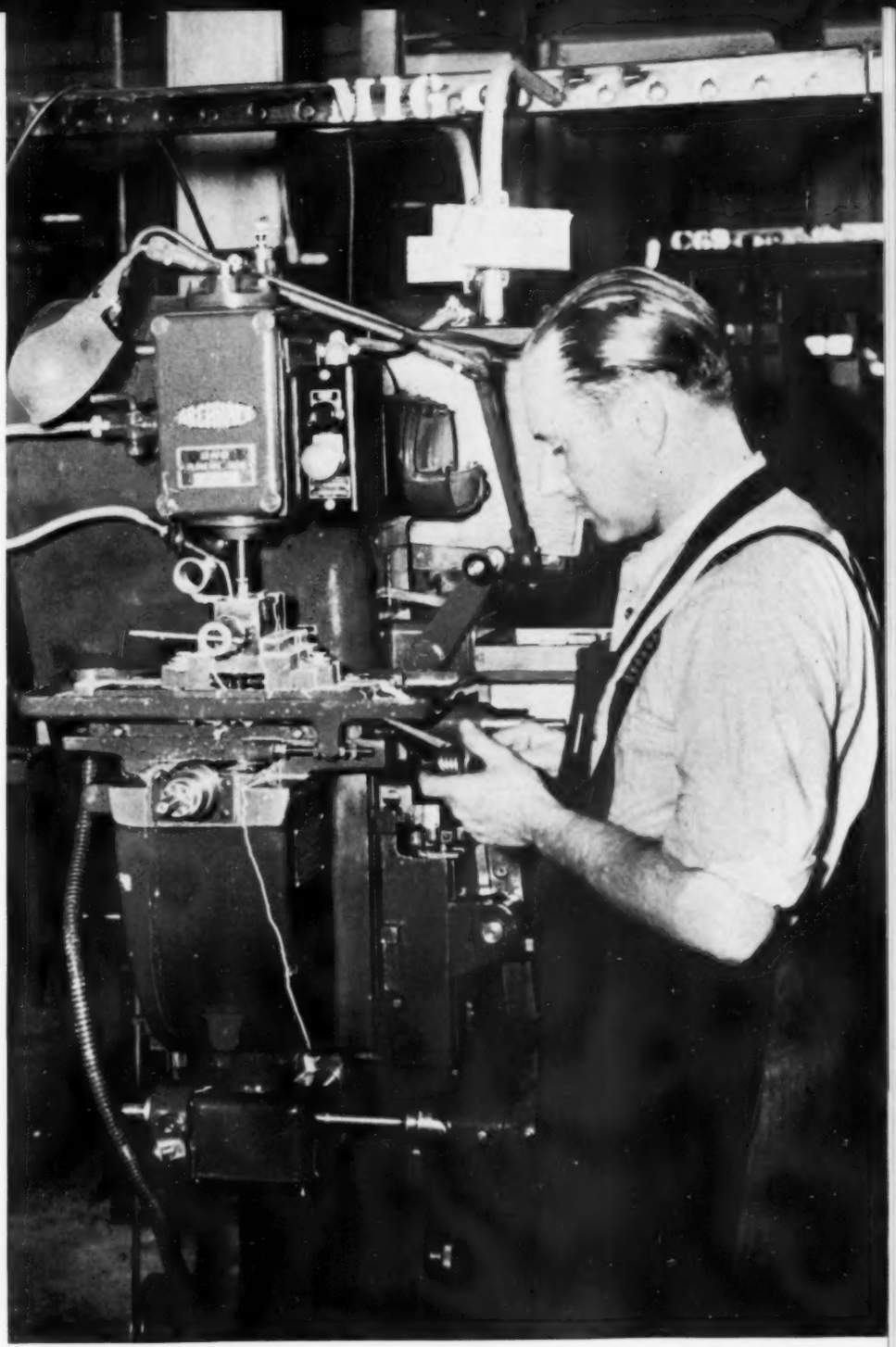
Finish milling the ribs on each side of the piston extension requires a machine that can work to a 0.002 in. limit despite variation in the cut. Furthermore, the finish must be acceptable for a part that is subject to rapid endwise movement. No grinding follows. The guiding ledge on one side of the piston is milled, then the piece is reversed in the fixture. The fixture holds two pieces, duplex vertical heads being provided on the machine





Two slide butts are rough milled simultaneously on a duplex Archdale. The forging is hardened and tempered to a D.P.N. of 220-270 (diamond pyramid number in Vickers hardness testing system), but the cutting speed is 61 surface ft. per min., and the feed is 1.65 in. per min. Time for rough milling the slide butt is 10¾ min.





For milling a slot in the barrel nut, or clamp, a ratchet feed moves the table of this Archdale machine up to the cutter. This action occurs at the end of each table oscillation, which is controlled by a face cam. Like many other machine gun components, the greater part of the original metal in the forging must be cut away in seemingly endless operations. Milling the slot in the barrel nut takes place approximately forty operations after stamping the batch number on the forging

Tooling against time

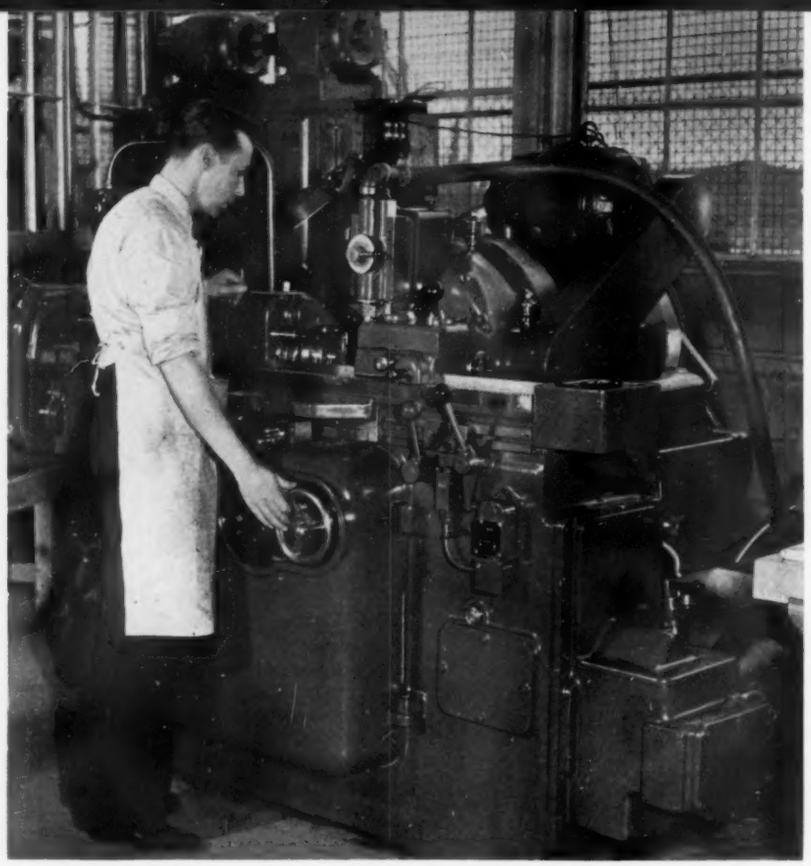
BEFORE BEGINNING components of the Bren gun, it was necessary to set up and staff a toolroom capable of making 17,604 fixtures, tools and gages. For strategic and cost reasons it was essential to make acceptable parts as early as possible and to keep up a steady flow of inspected material into the assembly department. It was argued that it is poor economy to stint or slight on toolroom work and be faced with heavy rejections after many costly operations have been performed.

This policy has begun to pay dividends. For one thing, it contributed largely to commencing actual assemblies five months ahead of schedule. Secondly, the first Canadian Bren gun was accepted in proving tests. Rejections are kept to a low figure.

A toolroom capable of producing a large volume of work to high precision standards is not a happenstance. The equipment used represents the best products of at least four countries. The men represent the pick of Canadian mechanics drawn from all parts of the Dominion. Most of them

(Continued on page 327)

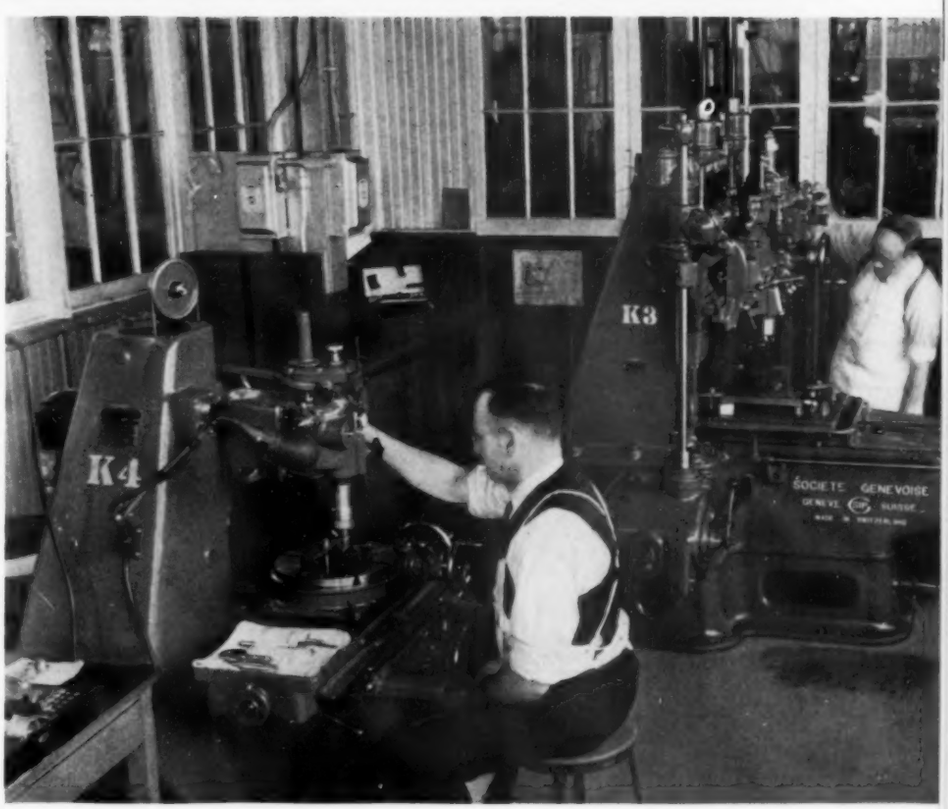
Accurate grinding of Whitworth thread gages to a tenth is an art in itself. This Jones & Lamson machine handles pitches from 14-48 threads per inch. Wheel dressing diamonds must be maintained to small radii. These radii are: 0.007 in. for pitches from 14-22; 0.004 in. for pitches from 23-32, and 0.0025 in. for pitches from 33-48.



First-class gage makers, drawn from all parts of Canada, work under ideal conditions. They are provided with every precision facility required in their work, including surface plates, angle blocks, channels, sine bars and several large sets of English and American precision measuring blocks

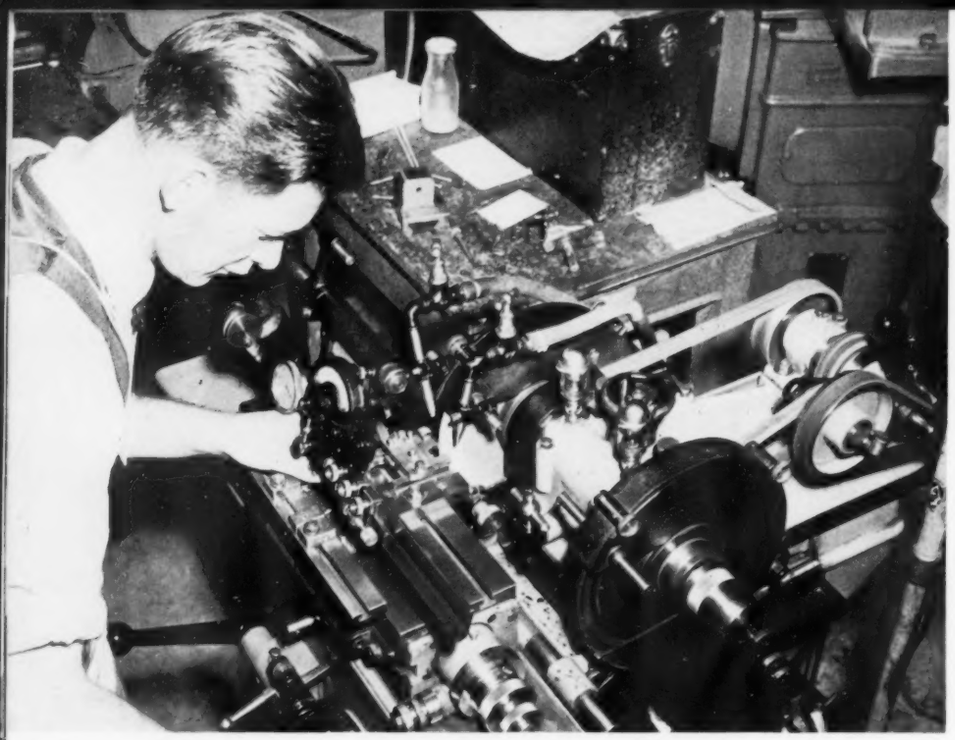
All gages, tools and fixtures produced by the toolroom, or purchased outside, must meet approval of the standards room, which is fitted out with highly accurate measuring equipment. Typical examples are the Pratt & Whitney electric gage that measures to 0.00001 in. and the Societe Genevoise machine that is adaptable to a wide variety of inspection operations, including three-wire measurement of thread gages. The standards room is maintained at a temperature of 68 F. the year around

Accuracy to a tenth or better is assured in jig and fixture work through the use of these Swiss borers



have had 15 to 20 years of experience, and they are all personally known to the master mechanic. About 100 men are employed, divided about equally on gage, tool and fixture work.

Workers in the toolroom are not hurried. Yet the combination of experience and ability possessed by these men promotes toolmaking without

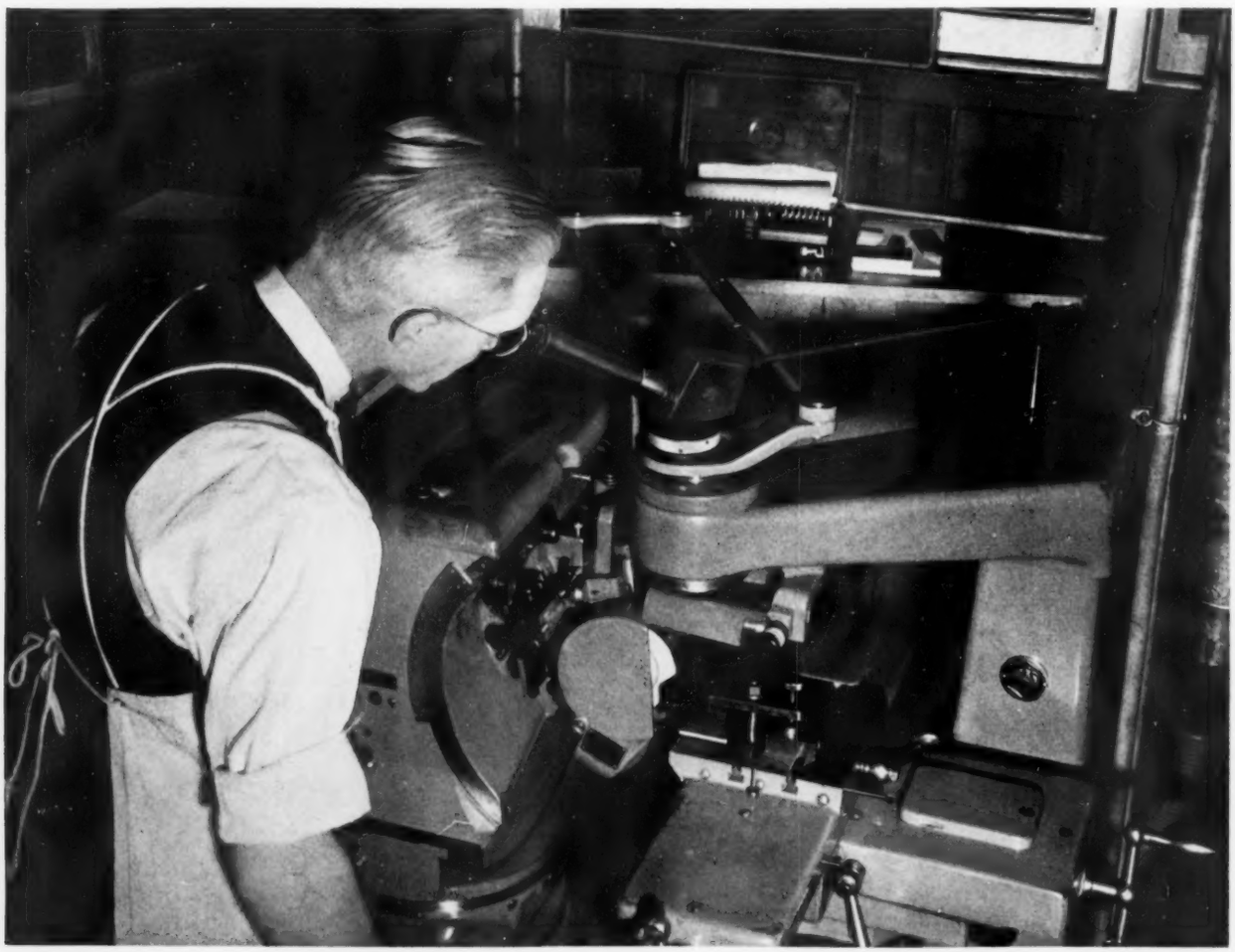


Double snap gages are being produced directly from heat-treated and sandblasted Brown & Sharpe flat stock in an average of two hours per gage. This practice affords important savings in time and cost; hundreds of such gages are required in production and inspection. The operator works to a tenth on a Studer combination grinding and lapping machine. The gage is held on three pins in the fixture. This method eliminates lack of parallelism between gage faces, a condition that often arises when flat stock distorts after the usual surface grinding and is then clamped on a gap grinder. Squareness is assured in the lapping operation because the table and fixture are traversed to the lapping wheel

waste effort and often with important time savings.

Abilities and capacities of outside vendors have been studied for the purpose of supplementing the production of the toolroom. At present, about fifteen vendors are used. It is said that the experience they have gained in gun work has raised the general level of ability in Canadian tool shops. Therefore, manufacture of the Bren gun in Canada has paved the way for other precision parts required by the military establishment.

A Loewe optical profile grinder rapidly turns out involved contours to a tenth, wheel movement being controlled by a 50:1 reduction from the drawn layout. The job in the machine is done in a day instead of several days by other methods. Male and female contour gages are made so accurately that they fit together with practically no light showing through at the mating surfaces



Canada supplies 40-mm. shells

CANADIAN PLANTS now possess sufficient experience in manufacturing 40-mm. shells to undertake war-time output. When educational order contracts were placed with several firms by the British Supply Board, precise information was not available concerning equipment and tooling needs. Yet now a steady stream of projectiles is being produced to the satisfaction of government inspectors.

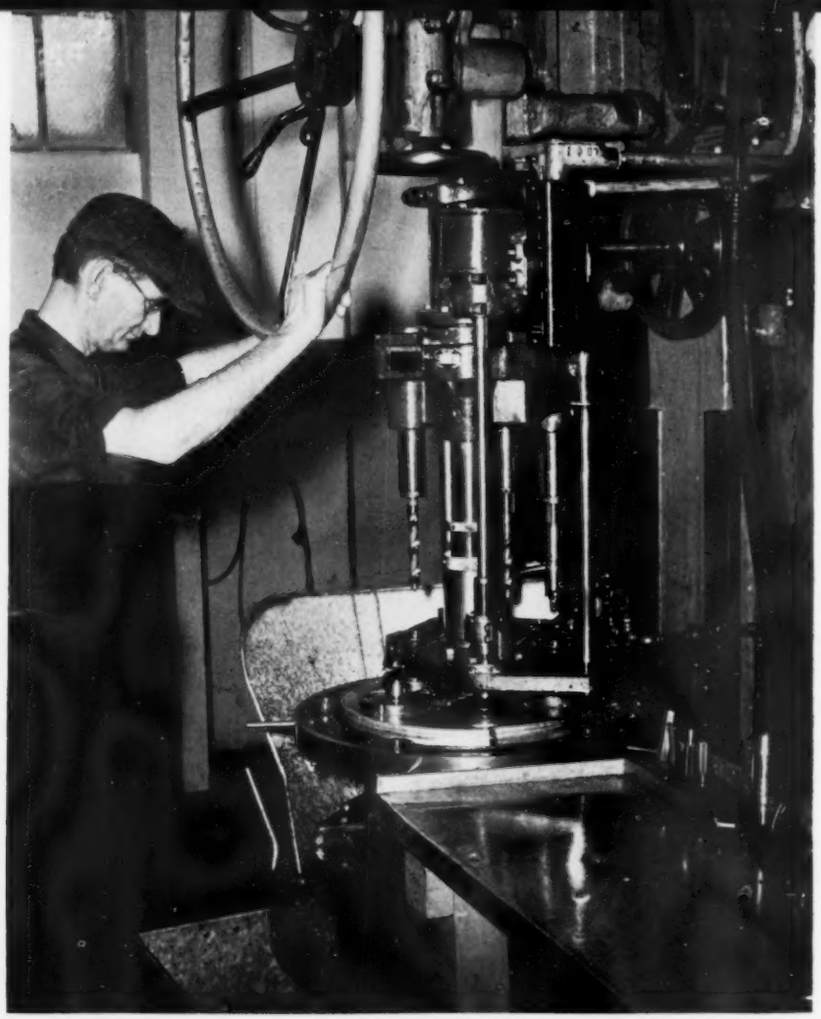
The 40-mm. shell involves production problems different from those employed for the better-known larger calibers. Assistance with tooling setups was not immediately forthcoming from equipment vendors, and it was necessary to experiment. Fortunately, a manufacturing technique well adapted to Canadian manufacturing plants has been worked out. Refinements in method will be adopted as production expands.

Because of its size, it is logical to machine the 40-mm. shell from bar stock, and to combine as many operations as possible on the new large-size automatic screw machines. For succeeding operations, it is desirable to adapt existing plant equipment to shell production, and to develop simple-operation machines that can be operated by women if necessary.

It should be emphasized that every step in production of the 40-mm. shell is constantly under the vigilant scrutiny of government as well as factory inspectors. This inspection is carried out from raw material to finished product, and the two inspection forces operate independently. Every heat of steel is checked in the mill for physical and chemical properties before it is rolled, and the finished bars are individually checked against specifications before shipment to the shell plant. Each machine operator is required to check his own work, and at definite stages factory and government inspectors make independent checks of all operations performed on the shell up to that point. When completed shells are passed by factory inspectors, the government inspection force makes a 100 per cent examination of each projectile before acceptance. There can be no compromise of quality in a military component.

Practically all operations on the outside diameter of the 40-mm. shell are semi-finished on an eight-spindle Conomatic screw machine. The chamber extending from the base to the nose is drilled, counterbored and tapped with a Whitworth fine thread. High-speed steel tools operate at a speed of 65 surface ft. per min., and the carrier indexes at 1 min. 40-sec. intervals.

In the second operation, drilling, counterboring and tapping are done from the opposite, or tracer, end of the shell. For this purpose a multiple-spindle head and independent leadscrew drive for the tapping spindle have been applied to an upright drill. The head is rigidly aligned with the five-position fixture by a heavy central guide post and two guide bars. The operator unloads and loads the fifth collet while the tools are operating at the other four positions of the indexing fixture



After degreasing, machining operations up to this point are checked by factory and government inspectors prior to application of the copper driving band. Inspection of the shells includes weight, concentricity, size, wall thickness, finish and the tapped holes.

Shells that pass the inte-mediate inspection are ready for application of the copper driving band. The operator slips a band over the recess in the shell body and inserts the loose assembly into the jaws of a hydraulic press. As the radially disposed jaws close, the copper driving band is squeezed tightly into the recess. A high-pressure plunger pump is required to obtain the necessary power to achieve plastic flow in forcing the copper band into place

Shaving the copper band to correct contour and size is done on another single-operation machine with work-loading and holding features similar to those employed on the "waving" machine. A tungsten-carbide form tool cutting at 650 surface ft. per min. produces a high finish on the band and retains its accuracy for long periods. Here the operator is shown checking his work with a snap gage

Shell interiors must be sealed with a special lead-free varnish. Loose plugs are inserted in both ends of the shell to keep varnish from the threads, and the assembly is laid against stops in a trough. The operator inserts the spray gun extension, presses the trigger and allows the gun to feed from the rear to the front under the action of springs on the fixture guide bars. Spraying is done into a DeVilbiss water-wash spray booth to prevent the operator from breathing varnish fumes. Baking the varnish follows in Canadian-made ovens. All shells are then inspected through the baked varnish because it is imperative that the charge does not come into contact with the steel

Women are again proving that they are capable of inspecting war material. These girls are government inspectors and perform the 100 per cent check required before acceptance of 40-mm. shells by the British Supply Board. They operate under the eye of an experienced male government employee

Molded plastics made to match

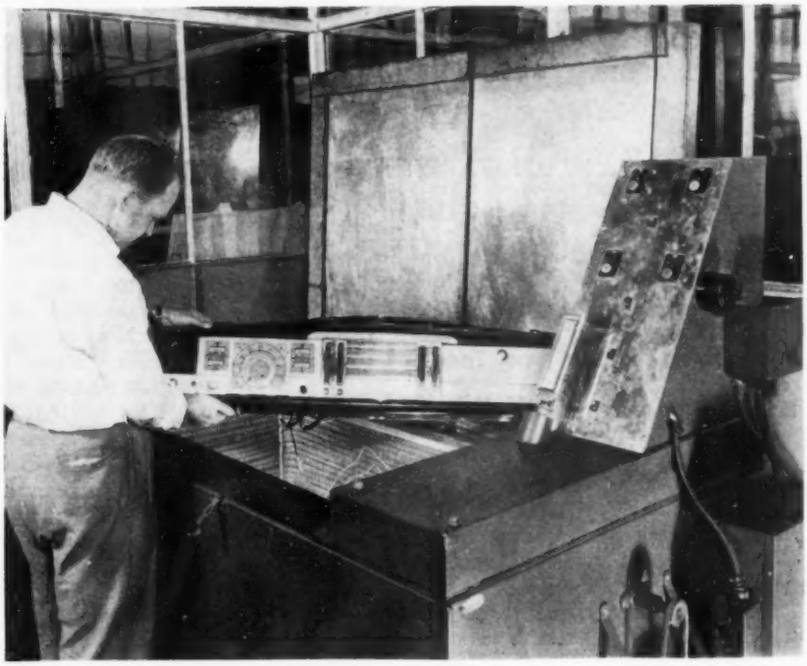
Seven molded plastic parts make up Chrysler's 1940 panel board. Colors match so well it looks like one solid piece

SEVEN PLASTIC PIECES comprise the instrument-panel decoration on 1940 Chrysler cars. These pieces are of different designs and molded from three separate formulas, yet they match in shade and depth of color and appear like one continuous piece across the entire dash.

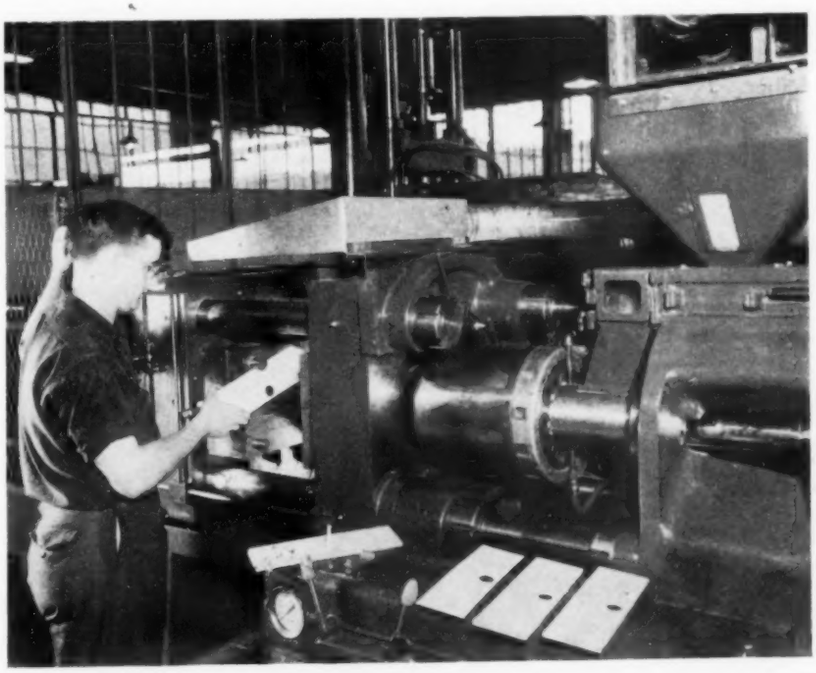
Control of light reflective value of each part begins with the design, but must be carried through the formulation of the plastic and into the method of molding. Vigilant control is exercised through all phases of the work by Chrysler's production research department.

Last summer the Chrysler Corporation equipped a department for making these injection-molded parts. Five injection molding machines of different makes were installed so that characteristics of each type could be studied under working conditions. A small hydraulic press was placed adjacent to each molding machine, and was equipped with suitable die sets for removing risers and flash. Molded parts have acceptable finish as they come from the machines; polishers and a bandsaw are utilized only for repair work.

Molding plastic over a steel glove-compartment door is one of the unusual operations being done. The stamping must be accurate, so that it locates properly in the mold. Otherwise, the injection pressure of 20,000 lb. per sq. in. will deform the steel backing plate and cause depressions or dimples on the surface that can not be hid by the plastic. Parts assembled to the back of the plate, like spot-welded studs, are accurately positioned and are without excess weld flash; this prevents the part from deforming under the molding pressure.



Assemblies are placed in this thermostatically controlled cabinet to study effects of temperatures between —20 F. and 180 F. on warpage and breakage under conditions approximating actual service. Great care is exercised in making the seven separate pieces which form the dash



Steel stampings for the glove-compartment door are white-enameled so that the depth of color of the plastic will not be affected by the steel gray of the metal underneath. The long plastic riser is placed over the lock opening, and is afterwards punched out on an adjacent hydraulic press

Equipment for chucking

BY J. R. LONGSTREET AND W. K. BAILEY, THE WARNER & SWASEY COMPANY

Set-ups for chucking jobs on the turret lathe do not vary as much as for bar jobs. There is less need for changing tools

UNIVERSAL TOOLING EQUIPMENT for chucking work represents about the smallest amount of tooling that should be available for each turret lathe in the shop. Such equipment held in permanent set-ups is just as important on chuck work as on bar work. Set-ups for chucking jobs do not require many changes of tools. When it is necessary to skip-index because of the permanent set-ups, the time lost is less important since, on chucking work, cutting time usually is longer per piece and per cut. Machine handling and indexing time therefore becomes less important.

The principle of the permanent set-up is the same for chucking work as for bar work. The tools that are used most often are mounted permanently on the machine in their most logical order. Such a set-up is shown in Fig. 64. Flanged tools are bolted to the turret face and left in place. Shank-type tools are used to adapt the permanent set-up to each individual job. Only when large quantities are to be produced is it necessary to remove or change the position of the flanged tools. For ordinary quantities, it is better to leave the tools on the machine and skip-index, or back-index if necessary, to obtain the proper sequence.

Overhead pilot bars are provided in universal sets of chucking tools. These bars may be of the type which fasten rigidly to the head of the machine and pilot into the turning heads, or they may be fastened to the turning head and pilot into a bushing on the head of the machine. The purpose of either type is to tie the turret of the machine to the headstock so as to provide greater rigidity, and to allow heavier cuts to be taken.

The stationary overhead pilot bar which fastens to the head of the machine can be heavier than pilot bars which are attached to the turning heads, since this bar does not add any weight to the hexagon turret and its tools. For this reason, this stationary bar can be larger in diameter and can provide a better support for the turning head. This type of bar can be adjusted endwise in the machine for various lengths of work, and can be clamped in place.

The attached-type overhead pilot bar which fastens to the multiple turning head, Fig. 63, also can be adjusted endwise, but because this bar rotates with the turret, it is not practical to make it as large and as heavy as the stationary type of bar. Generally speaking, stationary pilot bars are used for heavy duty or saddle type machines, and attached pilot bars are used for light-duty work on smaller, high speed machines.

The universal chucking equipment shown in Fig. 64 illustrates the use of adjustable single turning heads, such as shown at *A* in Fig. 65. Multiple turning heads, as at *B* in Fig. 65, may be substituted for these tools. The multiple turning head is designed so that cutters may be set in holders for turning any two diameters on a piece which is within the capacity of the machine. Two large diameters, two small diameters, or one large and one small diameter, may be turned at the same time by placing the reversible adjustable angle cutter holders in the proper holes in the multiple turning head.

The adjustable single turning head shown at *A* in Fig. 65 provides for the quick setting of a cutter for any one diameter. The entire block, which holds the cutter head, can be moved up and down. To change from one size to another, while setting up, the

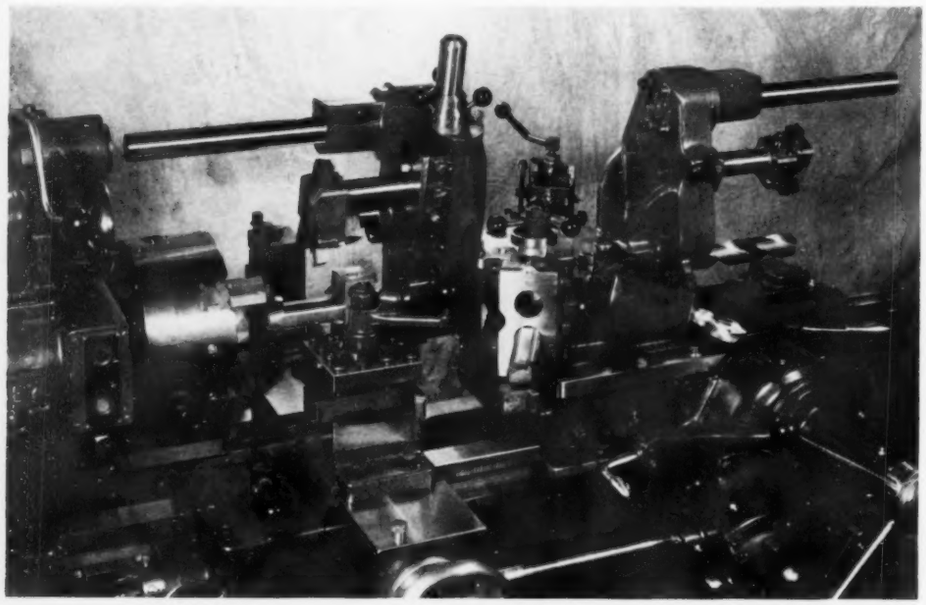


Fig. 63—Overhead pilot bars attached to turret tools swing with the turret when it is indexed. They permit heavier, more accurate cuts

block is adjusted to size by turning the handle; the size being shown on a large dial. The head has a second hole which will position an angle cutter holder for turning a large diameter. Thus, with this head, cutters can be set to turn two small diameters, or one large and one small diameter.

Savings in set-up time when using the adjustable single turning head will, in many cases, offset the advantages of taking multiple cuts on small quantity work. However, if a machine is to be used to produce large quantities, the work should be analyzed to determine whether the advantages of multiple cuts can be obtained by using the multiple turning heads instead of adjustable single turning heads.

To illustrate the use of the universal chucking equipment, we will follow through all of the operations on a simple chucking job, just as was done for typical bar work previously discussed. (*AM*—Vol. 84, page 202). The double gear shown at *A* in Fig. 66 is such a chucking job. The gears are to be machined all over to the limits shown. Concentricity of the outside diameter of the gears to the hole must be within 0.003 in. on a full indicator reading. Quantity to be produced by the first set-up will be five pieces.

Since the piece is small and there are no long or extra heavy cuts, a ram type universal machine is a logical choice. Although the diameters and concentricities do not have to be extremely accurate, it is good practice when facing and turning cast iron, to take two cuts; one for roughing and one for finishing. This will not only improve accuracy, but also provides a better finish. Ordinarily, roughing and finishing cuts should be taken with different cutters, but as only five pieces are to be machined in this case, roughing and finishing can be done with the same cutter.

The hole in the gear has to be machined from the solid, and it is the best practice, therefore, to start drill, drill and bore. If a reamer is not available, the semi-finish boring cutter also may be used to take the final boring cut.

A study of all possibilities shows that the job should be done in two chuckings. In the first chucking, at *B* in Fig. 66, we should combine the facing of (2) with the turning of diameter (1). We will not attempt to combine the boring with the turning because only five pieces are to be made. It is more important to be able quickly to adjust the boring cutter than it is to combine the cuts. For this reason, the boring bar is placed in a slide tool so that it can be adjusted quickly and easily for both the semi-finish bore and the finish bore. In the second chucking, at *C*, we can combine the turning of diameter (7) with the facing of (5) and (8).

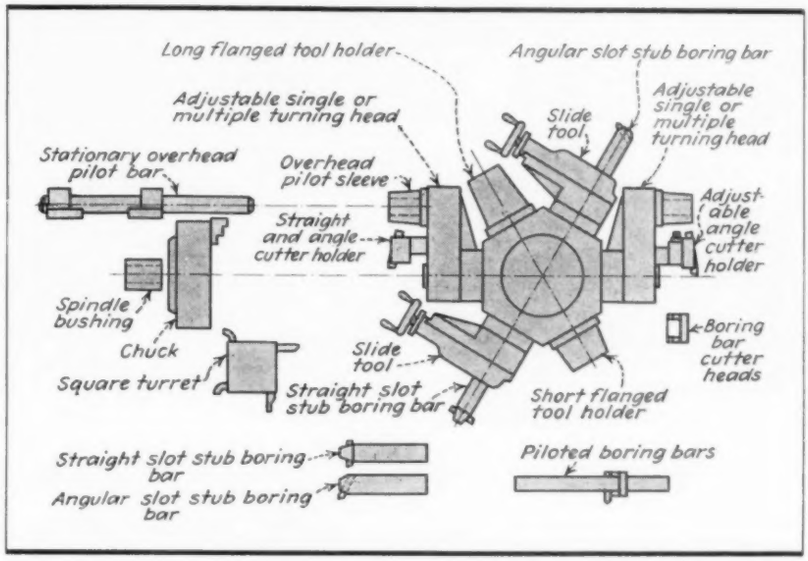


Fig. 64—In a permanent set-up for chucking work the tools used most frequently are mounted in logical order on the machine. It is necessary to remove or change position of flanged tools on the turret only when large quantities are to be produced

Order of operations is: I, chuck; II, start-drill (3); III, drill (3); IV, rough turn (1) and rough face (2); V, finish turn (1) and finish face (2); VI, semi-finish bore (3); VII, finish bore (3); VIII, chamfer; IX, file radii (4); and X, remove piece from chuck. For the second chucking the operations will be: I, chuck; II, rough turn (7), rough face (5) and (8); III, finish turn (7), finish face (5) and (8); IV, recess (6); V, chamfer (9); VI, file radii (10); and VII, remove piece from chuck.

The back stop for the first chucking is a piece of $\frac{1}{4}$-in. cold rolled wire bent in the form of a loose ring and placed between the piece and the step on the chuck jaws. This provides clearance between the jaws and the back edge of the casting for the turn-

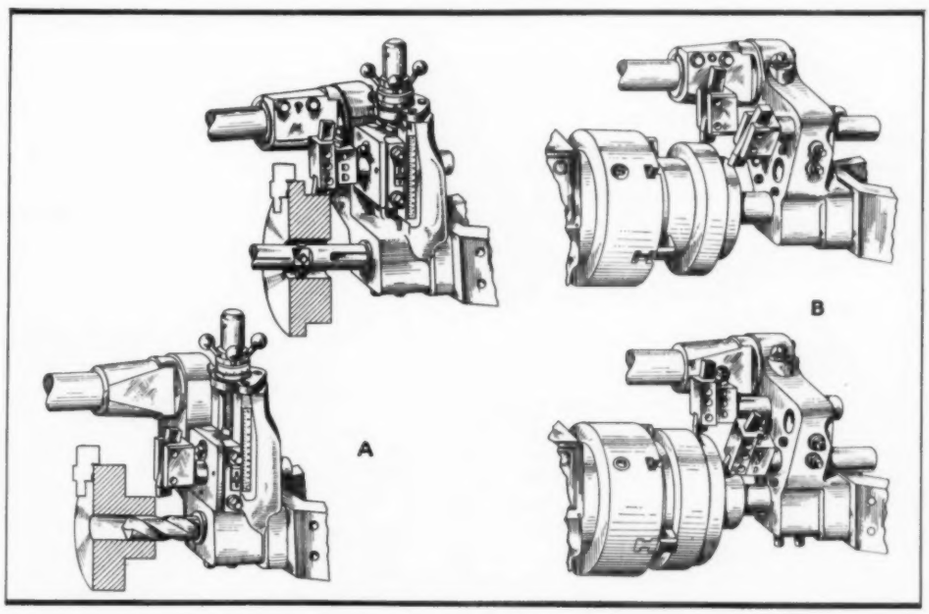


Fig. 65—Adjustable single turning heads, A, provide for quick setting of a cutter for any one diameter. Multiple turning heads, B, are used for turning any two diameters within the capacity of the machine

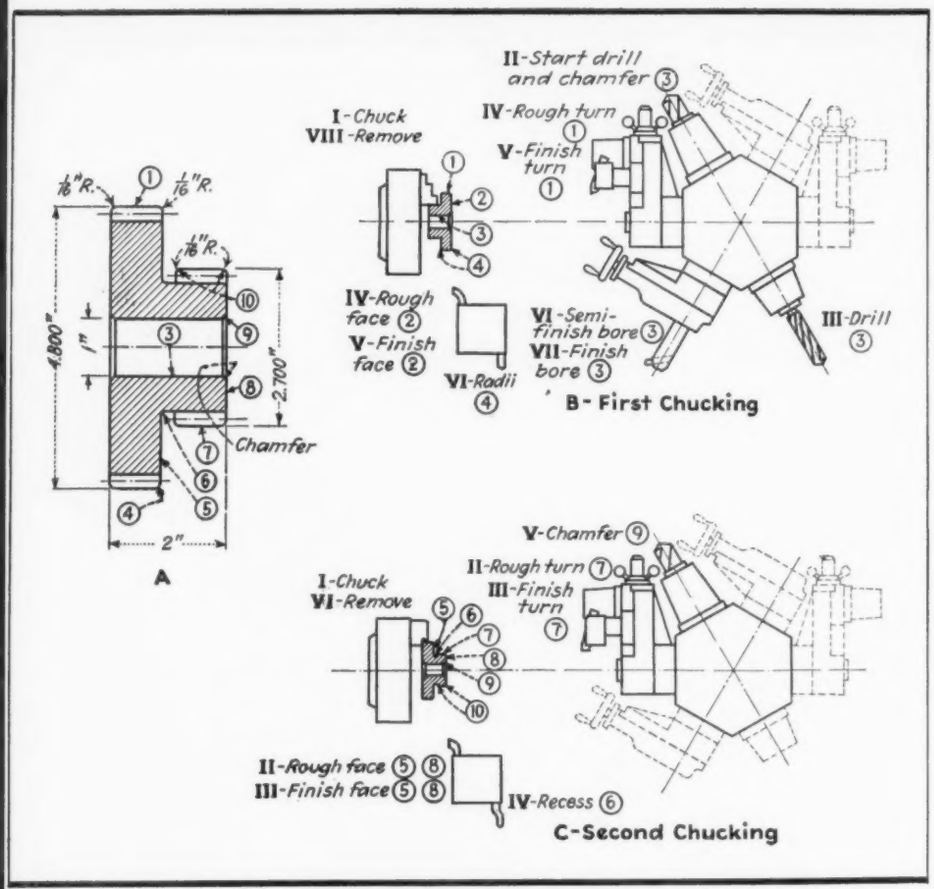


Fig. 66—The gear A, *when made in small lots, should be machined in two chuckings, as at* B *and* C. *Only two machine stops need be set*

ing cuts on diameter (1). The back stop for the second chucking is the face at the bottom of the bore of the soft jaws.

The use of soft jaws in the second chucking makes it possible to keep the outside diameters concentric within the limits specified. Because only five pieces are being made, only two machine stops are set, one for finish facing operation *V* in the first chucking, and the other for finish facing operation *III* in the second chucking. Both of these stops are for the cross slide. To obtain the distance between face (2) and (5) in the second chucking, a simple bar gage is placed between the stop rod and the stop screw, which already has been set for face (2). If less than five pieces are being made many operators would not set any stops and would use scale measurements only.

In the previous discussion of the economics of bar set-ups (*AM*—Vol. 84, page 202), a careful study showed exactly how the set-up, work handling, machine handling and cutting time should be changed when producing different quantities. The same principles apply to chucking work. As quantities increase, set-up time becomes less important because the set-up time per piece is reduced for each increase in quantity. Therefore, as quantities increase, we can afford to spend more time in setting up the job, provided we reduce the cutting time and the machine handling time.

The double gear shown in Fig. 66, when produced in quantities of 50 to 75 pieces, should be set up according to layouts shown in Fig. 67. One principal change in these set-ups is that with 50 to 75 pieces to be made, separate cutters will be used for roughing and finishing cuts. This will increase the life of the cutters between grinds and will produce a better quality of finish. It also will decrease the machine handling time because it will not be necessary to adjust the cutters between roughing and finishing cuts.

In the first chucking operation, at *A* in Fig. 67, the turning of diameter (1) and the drilling of the hole (3) are combined with the facing cut (2). The semi-finished bore remains the same, but the hole is sized with a reamer instead of a finish boring cut. In the second chucking, at *B* in Fig. 67, the finish turning of diameter (7) and the chamfering of the hole (9) are taken as multiple cuts and combined with the finish facing of (5) and (8). These facing cuts (5) and (8) are taken as multiple cuts by placing two cutters in a standard two-

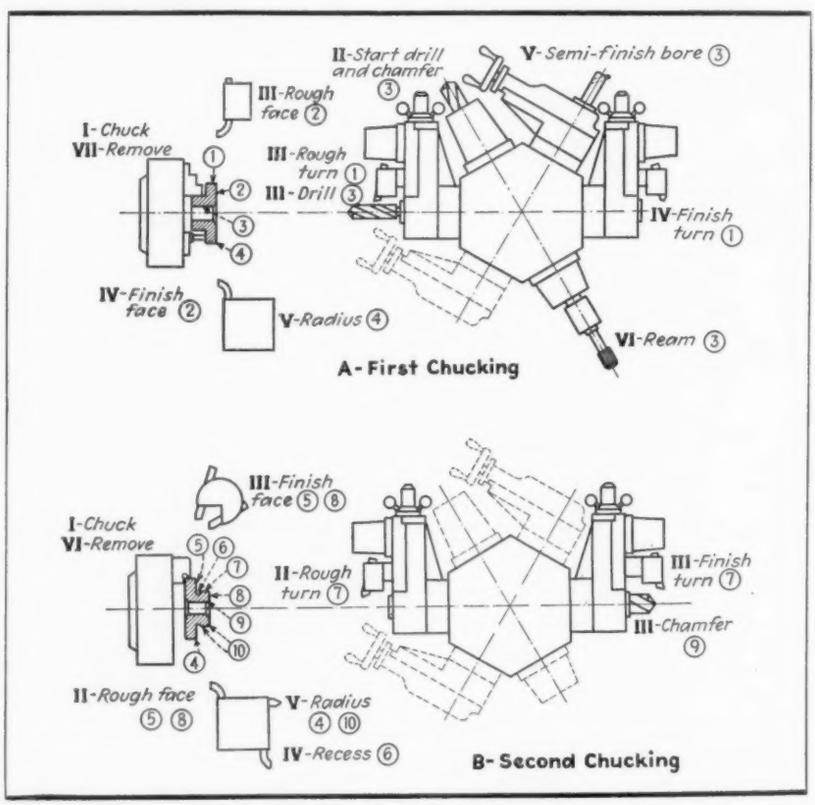


Fig. 67—When lot size is increased to 50–75 pieces, the gear shown in Fig. 66 would be machined in two chuckings with the set-ups shown

cutter rear facing block, as shown in Fig. 68. Another change in set-up is the use of adjustable back stops instead of the loose ring.

While Stellite cutters might have been used on the five-piece lot because all of the cutters are standard shapes, they certainly should be used when producing a 50 to 75-piece lot. With Stellite cutters, speeds can be increased with the result that cutting time will be reduced, and total production time per lot also will be reduced. Stops should be set for each turret and cross slide operation when using the set-up shown in Fig. 67.

Fig. 69 shows how the layouts for the first and second chucking operations should be changed if the quantity is increased to 500 pieces per lot. In this case, combined and multiple cuts are developed to the fullest possible extent. The multiple cuts used in medium-lot layouts are used here, and others are added. In the first chucking, at *A* in Fig. 69, operation IV, the semi-finish boring cut (3), the finish turning cut (1) and the radius cut (4) are taken as multiple cuts. The reamer held in a slide tool can be located accurately on center.

The second chucking, at *B* in Fig. 69, operation III, the finish turning of (7) and the cutting of radii corners (4) and (10), are taken as multiple cuts with the turning head. This is done by using a stub boring bar and a chamfering head as shown in Fig. 70. The multiple cuts are combined with the finish facing of (5) and (8), which also are taken as multiple cuts by means of the special block mounted in the square turret.

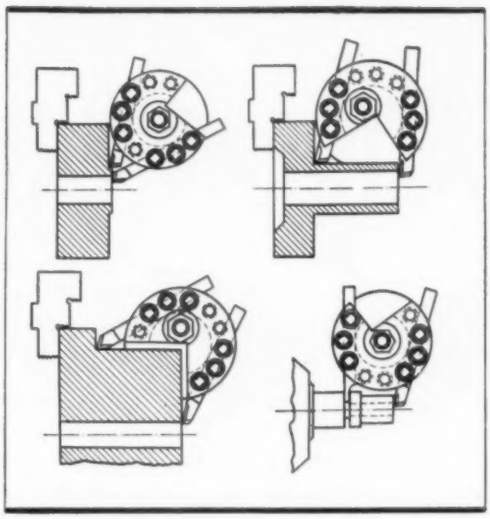


Fig. 68—Two-cutter rear facing blocks are mounted on the cross slide and permit two operations to be combined conveniently

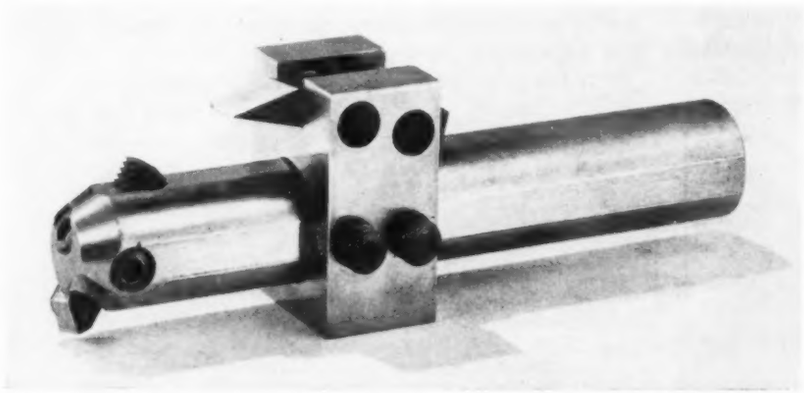


Fig. 70—Multiple cuts frequently can be incorporated in a tooling layout by using a stub boring bar fitted with a chamfering head

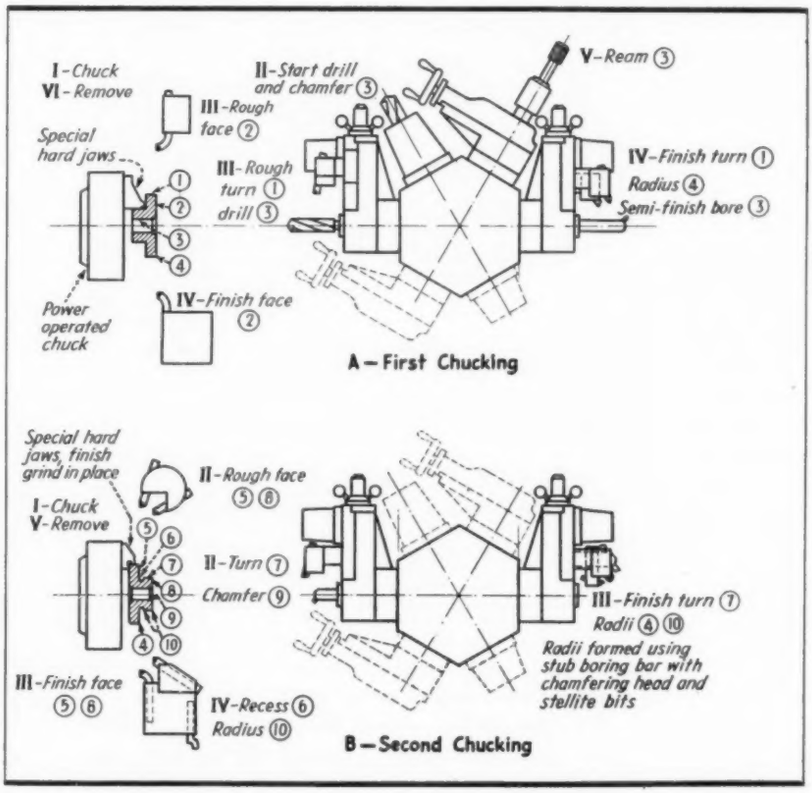


Fig. 69—Set-ups for first and second chuckings, A *and* B, *on the double gear are designed to reduce cutting time when machining 500-piece lots*

With a 500-piece lot, tungsten carbide cutters are used, since such cutters permit the use of higher speeds and greatly decrease the cutting time per piece. The work-handling time can be reduced by using a power-operated chuck and special chuck jaws. The power-operated chuck can be of the air, wrenchless, or electric type, depending upon what the shop has available and the other work scheduled for the machine. Special chuck jaws will grip the work more rigidly, permitting the use of heavier feeds and the use of combined and multiple cuts.

The increased cost of tooling on the basis of a 500-piece lot is more than offset by the time saving made. As a matter of fact, the only special items are two sets of special chuck jaws, one special recessing cutter, one special tool block and several small cutter bits. The other cutters all are of standard shapes and sizes and can be used on other work.

It should be noted that in all three of these layouts, for 5, 50-75 and 500 pieces, that the basis of the tooling is the universal chucking equipment. No special items were added until the 500 piece layout was made, and then only a few special tools.

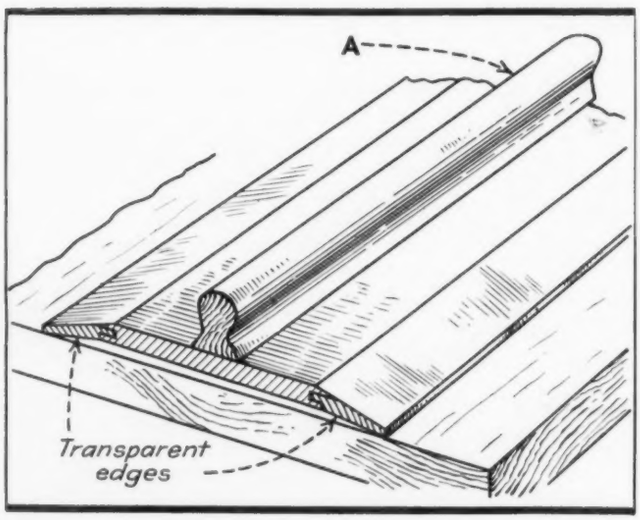
From a forthcoming book on turret lathe operation.

IDEAS FROM PRACTICAL MEN

A Suggested Improvement in Straight-Edges

By F. L. SOUTHWICK

Why the makers of drafting equipment have never furnished straight-edges or parallel rulers like the one shown in the illustration is one of the minor mysteries. The transparent edges should be so attached that they will keep the blade proper $\frac{1}{16}$ in. above the paper, supporting it on flats along the entire length. The



The edges of this straight-edge are so attached that they keep the blade $\frac{1}{16}$ in. above the paper. Among other advantages, the small area of contact with pencil drawings will reduce smudging

small area in contact with the paper will reduce the smudging caused by dragging a flat straight-edge over the drawing and which cannot be avoided by lifting the straight-edge because there is no place to grip it.

If the ruler be equipped with a grip-rail as shown at *A*, the ruler can be lifted by one hand and the paper can be slid under it with the other. Perhaps the best job it does is to prevent pencils and erasers from rolling off a board that has much tilt.

Adapters for Lathe Chucks Not Recommended

By ARTHUR SILVESTER
Crucible Steel Company

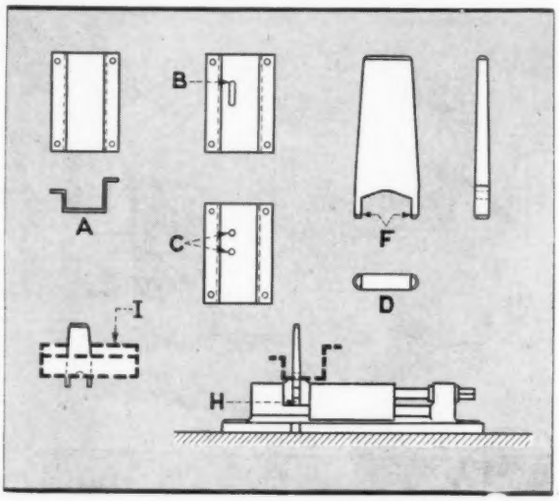
Some lathe operators are not careful to keep the threads on the spindle nose and in the chuck plate clean and to keep the chuck, when not in use, in a place where chips and dirt will not get into the threaded part of the chuck plate, resulting in the chuck sticking fast to the spindle nose. Therefore I do not think the adapter described by William A. Spellman (*AM*—Vol. 84, page 176) will be generally adopted, even in small shops. If the adapter should be stuck on the spindle nose or in the chuck plate, some operators would try to remove it with a cold chisel and a hammer, even though holes were drilled in the collar for a pin or a spanner wrench, resulting in damage that would cause the chuck to run out sidewise the next time it was used.

On the other hand I have known adapters to be used successfully in some small toolrooms where care in the use of equipment was the rule rather than the exception. But even so, I believe it is generally economical to equip each lathe with its own chuck.

Improvised Piercing Tools for a Rush Job

By EMIL WITTMANN

The part *A* is made of $\frac{1}{16}$-in. half-hard brass and is used in an electric appliance, being kept in stock in large quantities. Recently a rush order was received for 500 of these parts, but with the addition of a slot



This improvised hand-operated tool was made to fill a rush order for parts already in stock but which had to be slotted for a special purpose

at *B*. Since delivery could not be delayed, the tools illustrated were improvised for cutting the slots.

With the aid of a simple plate jig, two holes were drilled at *C*. The punch *D*, having two pilots *F*, was made from cold-rolled steel and casehardened, the center distance of the pilots being the same as that of the drilled holes. In place of a die, the tops of the

hardened jaws of a machine vise were ground to a sharp cutting edge, and between the jaws was placed the spacer *H* having a thickness equal to that of the punch plus the correct amount of clearance for a clean cut. With the pilots of the punch inserted in the drilled holes, as at *I* and the work placed on top of the vise jaws with the pilots of the punch between them, three light blows with a hammer sheared out the piece between the drilled holes, leaving the slot. The 500 parts were slotted in three hours.

Press Tools for Piercing Slots

By CHARLES H. WILLEY
Superintendent of Manufacturing
Hoyt Electrical Instrument Works

In piercing slots in oval meter rims, such as the one shown at *A*, to let light from a small lamp shine through and illuminate the meter dial, the punch must be operated inside the rim. The job requires two sets of tools, the set at the left being for piercing the slot *B* in the end of the oval. The rim is placed in the nest *C* which frames it and is located by one of the ears engaging the notch *D* in the small angleplate in front of the die, the rim being held against the face of the nest by its flange. The punch *F* is in the inside of the rim and its up stroke is controlled by the rubber buffer *H* and its down stroke by setting the ram.

In operation, when the ram descends, a shank held in it contacts the top of the punch holder and forces the punch down, compressing the rubber buffer and piercing the slot. On the upstroke of the ram the rubber buffer expands and raises the punch. Since the work is confined in the nest it is automatically stripped from the punch, which comes to rest in the starting position as the rubber buffer reaches the limit of expansion.

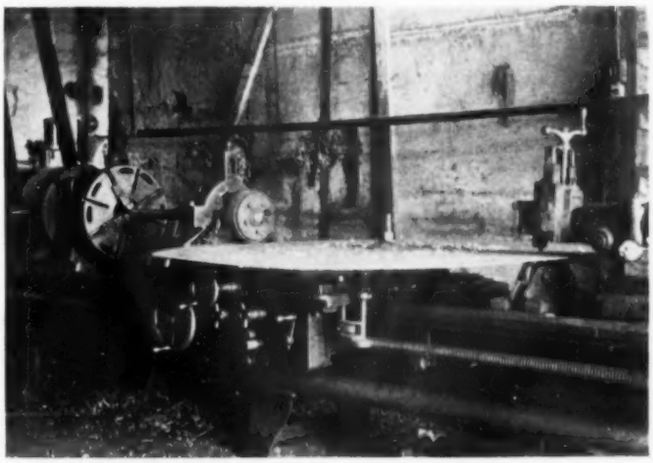
The outer slot *I*, in the long side of the oval, is pierced in the same manner by the tools at the right. Like parts are denoted by like letters in both views.

A 51-in. Hole Bored on a 27-in. Lathe

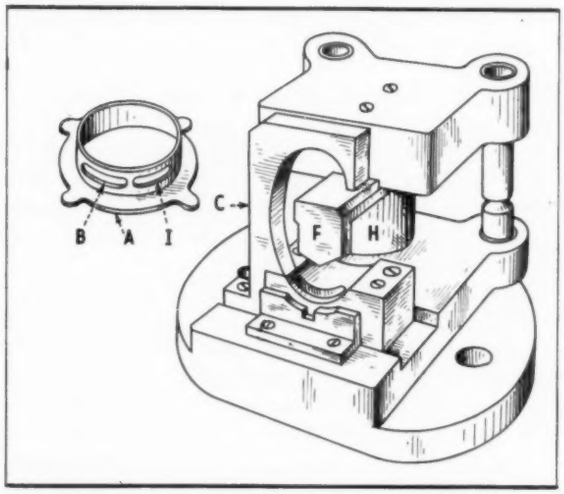
By D. L. WHEELER

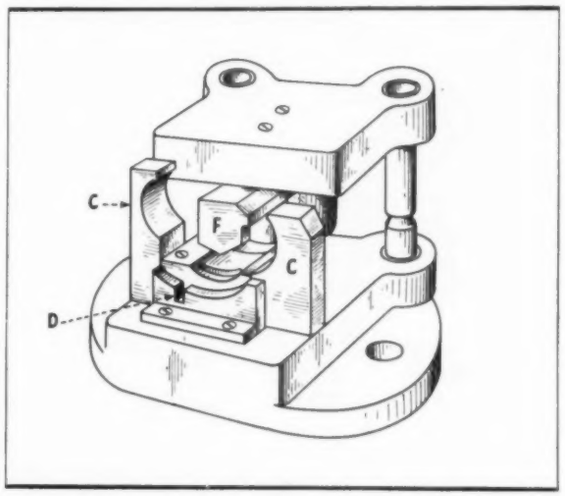
Our shop at the Williamette Valley Lumber Company had to make two-fan impellors, each side plate of which had to be bored accurately with a large hole. Four side plates, $\frac{3}{16}$ in. thick and 61 in. diameter were used. Two of them required a 31-in. bore, while the other two required 51½-in. holes. We did not wish to flame-cut the holes, because we were afraid the heat would warp the plates.

We decided to bore the holes on a 27-in. lathe using the illustrated set-up. We keyed a 10-in. paper friction head on a shaft 3 ft. long, chucked it in the lathe, and ran the shaft through a bronze bushing held in a steady rest. Under the friction head we placed two large ball bearings mounted between two angle irons to take the friction-head thrust. Then



This 61-in. plate was bored with a 51½ in. hole by supporting it on rollers on the lathe carriage and using a parting tool set in the shaper head mounted on the tailstock. The plate was turned by the friction head supported by a steady rest





Separate sets of tools are required for piercing the slots in the ends and sides of oval meter rims. The rims are held in a nest and located by one of the ears engaging a notch in the small angle plate

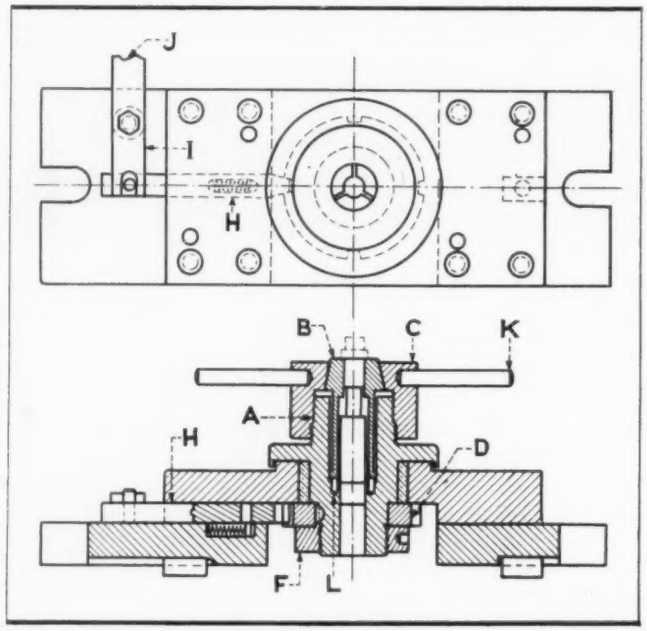
a 1½-in. center hole was drilled in the plates to fit a short arbor, which was bolted to the carriage vertically on the center line of the machine, and free to turn on a bearing. A head from an old draw-cut shaper was mounted in the tailstock to hold a narrow parting tool. Two additional rollers were placed under the tool, thus completing the set-up. A little crude perhaps, but it worked perfectly.

Indexing Milling Fixture for Small Production

By JOHN JERGENS
Engineering Department
Cleveland Pneumatic Tool Company

A large variety of parts produced in screw machines in lots of from 100 to 500 required milling as a second operation. Accordingly, the illustrated indexing fixture was made.

The body of the fixture is planed on the bottom and has two short tongues that fit into one of the slots in the milling machine table and is bored for the spindle *A*. The spindle is bored to receive the collet *B*, threaded for the cap *C* and is carburized, hardened and ground. The indexing ring *D* has the



Screw machine products that are required to milled as a second operation are held in a spring collet in the spindle of this indexing fixture

requisite number of tapered notches and is keyed to the spindle, being locked thereon by the collar nut *F*. The spring-actuated index latch *H* is tapered on the end that engages the notches in the index ring and is withdrawn therefrom by the pivoted lever *I*, the inner end of which only is shown. The collet is tightened on the work by screwing down the cap by means of the cross pins *K* which are also used for turning the spindle in indexing. The collet is slotted at its lower end for the driving pins *L* which prevent it from turning in the spindle.

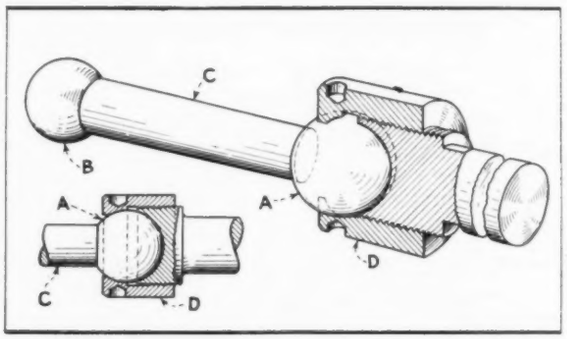
Indexing is done by withdrawing the latch *H* from the index ring by lever *I*, turning the spindle and letting go of the lever so that when the next notch in the index ring is opposite the latch, the latch is snapped into it by the spring.

If desired, the fixture can be attached to the vertical member of an angle plate that is provided with a slot to fit the tongues at the bottom. Other means of holding the fixture can be made for different uses.

Setting the Miller Table at the Spindle Center

By CHARLES HOMEWOOD

To set the milling machine table a predetermined distance from the center of the spindle, the common practice is to hold a short piece of round stock in a collet or a chuck in the spindle and turn it by a tool



By the use of this little device, the distance from the milling machine table to the center of the spindle is measured accurately and conveniently

held in the vise until the outer end runs true, then check the distance of the table from the center of the spindle by measuring from the under side of the turned piece, allowance being made for one-half its diameter.

The little device illustrated was designed to eliminate the necessity for truing the turned piece each time the table is to be set for another job. It consists of the balls *A* and *B* soldered to the ends of the rod *C* which have been hollowed out to fit the balls. In use, ball *A* is held in the collet-like fixture *D* in the spindle. Ball *B* is made to run true by bringing fixed object attached to the table into contact with it while the machine is running. Then with the machine stopped, the fixture is tightened securely on ball *A*. The table is then adjusted to the required distance from the center of the spindle, measurement being taken from the under side of ball *B*, to which, of course, must be added one-half the diameter of the ball. The advantage of using a ball to measure from is that its diameter remains constant, since it does not have to be turned each time the table must be set for a new job.

AMERICAN MACHINIST REFERENCE BOOK SHEET

Weight of Bar Stock—I

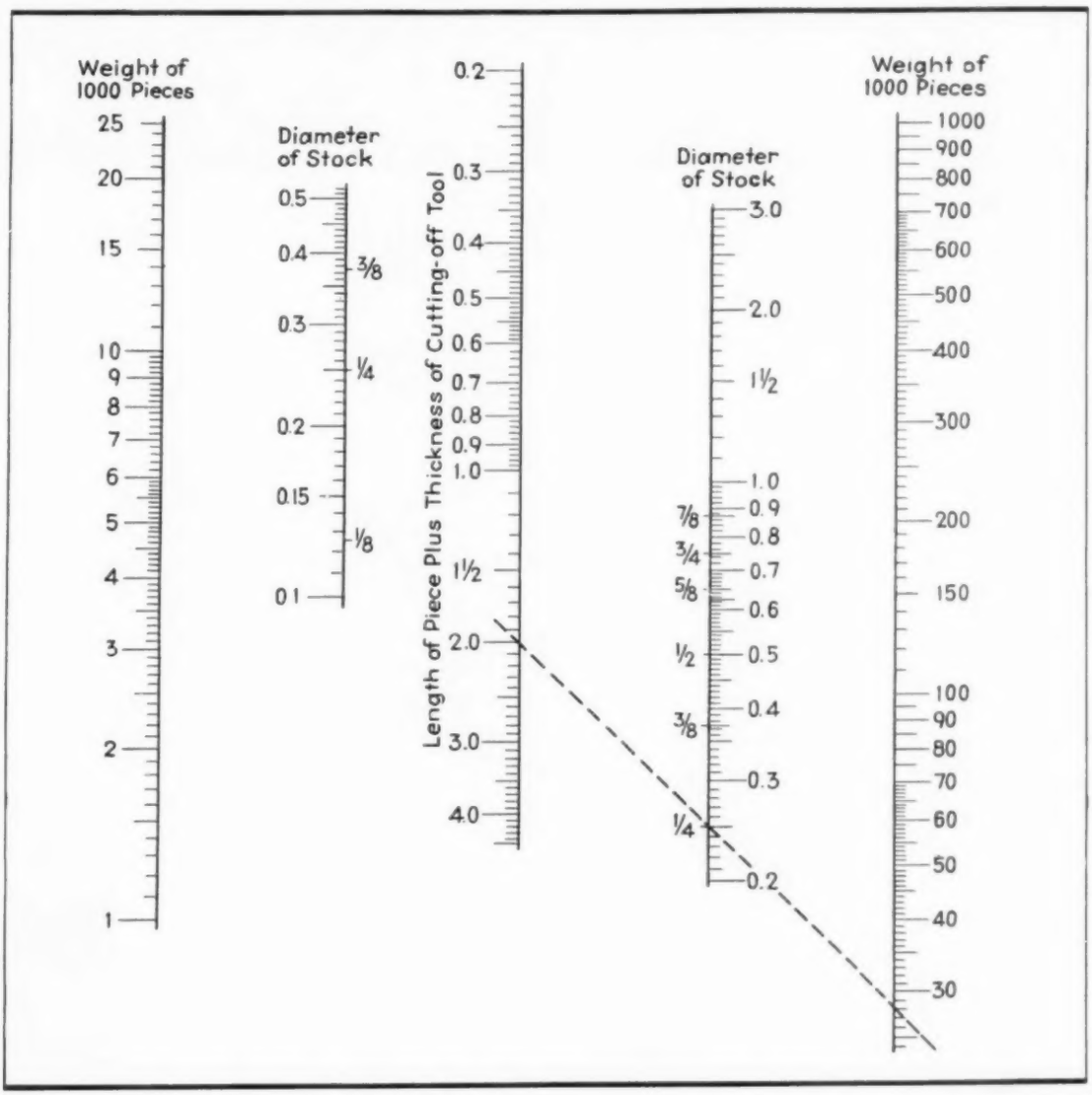
BY LOUIS de L. BERG

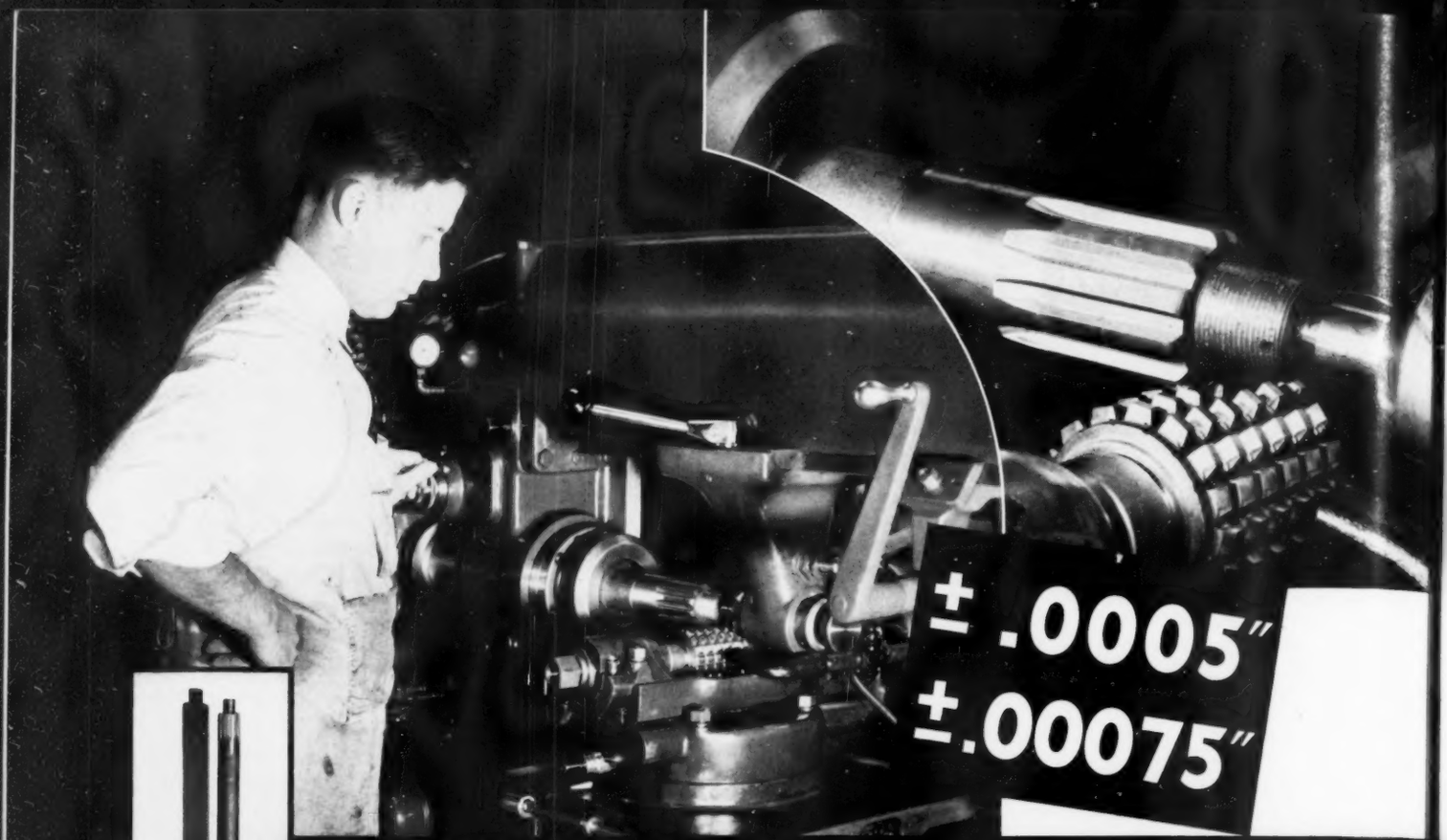
Round Steel

THIS CHART is used to determine the weight of round steel bar stock required for 1,000 pieces of known diameter and length within a range of approximately 0.10 in. diameter by 0.20 in. long to 1½ in. diameter by 4 in. long. There are two diameter scales and two weight scales on the chart. Care must be taken that the weight scale is always read on the same side of the chart as the diameter scale.

DIRECTIONS—Ascertain the diameter of the stock to be machined and the length of the finished piece; add to the latter the width of the parting tool. Using this diameter and length, draw a line through the diameter and length scales until it intersects the weight scale. The reading on the latter will give the weight of round steel stock necessary to machine 1,000 pieces.

EXAMPLE—The weight of ¼-in. round steel bar stock required for 1,000 pieces 1 5/16 in. long (add 1/16 in. for the width of the parting tool) is 28 lb.





ACCURACY IN "TENTHS"

For Your Spline Shafts . . . . .

ON BARBER-COLMAN HOBBING MACHINES

Here's the Set-Up

Name of Part — Rear axle shaft.

Operation — Hobbing involute splines, one long and one short, on opposite ends of shaft.

Hobbing Machines — Barber-Colman; three Type A and one Type D.

Material — 1045 H.R. steel; 269-321 Brinell; machined after heat-treatment.

Feed and Speed — .082" feed; 82 r.p.m.

Production — 110 splined ends on 55 shafts completed in 8 hours on 4 machines.

Accuracy — Between opposite splines: ± .002"
Between adjacent splines: ± .0005"
Profile: ± .00075"
Parallel with bearing: ± .001" in 6"

Splines; Involute Type	Short Spline	Long Spline
Outside diameter	2.355"–2.345"	2.505"–2.495"
Length, full cut	2¼"	12⅝"
Number of splines	10	12
Pitch diameter	2.209	2.3875
Pressure angle	30°	30°
Root diameter	1.985"	2.234"

Hobs; Barber-Colman Class A, Single-thread	
Size	3¼"x4"x2", taper hole
Gashes	15 / 16
Number settings	18 / 18
Pieces per setting	8 / 3

With Barber-Colman Hobbing Machines, it's easy to hold close limits and get low cost production on splines or other hobbed forms.

For instance, a tractor manufacturer uses three Barber-Colman Type A's and one Type D Hydraulic as a highly profitable production group for hobbing involute splines on the ends of axle shafts illustrated. The four machines complete 110 splined ends on 55 shafts in 8 hours; maintaining limits as close as ±.0005" and ±.00075". See data at left.

This performance is the result of unexcelled precision, power, durability and operating convenience built into Barber-Colman Hobbing Machines. It's quite possible that Barber-Colman Engineers can suggest equally profitable methods for your plant . . . Consult them freely; no obligation.

Barber-Colman Type A and Type D Hobbing Machines are fully described in Bulletins 1099 and 1477, respectively. Write for copies, today.

BARBER B-C COLMAN PRODUCTS
HOBS, HOBBING MACHINES, HOB SHARPENING MACHINES, REAMERS, REAMER SHARPENING MACHINES, MILLING CUTTERS, SPECIAL TOOLS

Barber-Colman Company

General Offices and Plant 201 Loomis St., Rockford, Illinois, U. S. A.

Weight of Bar Stock—II

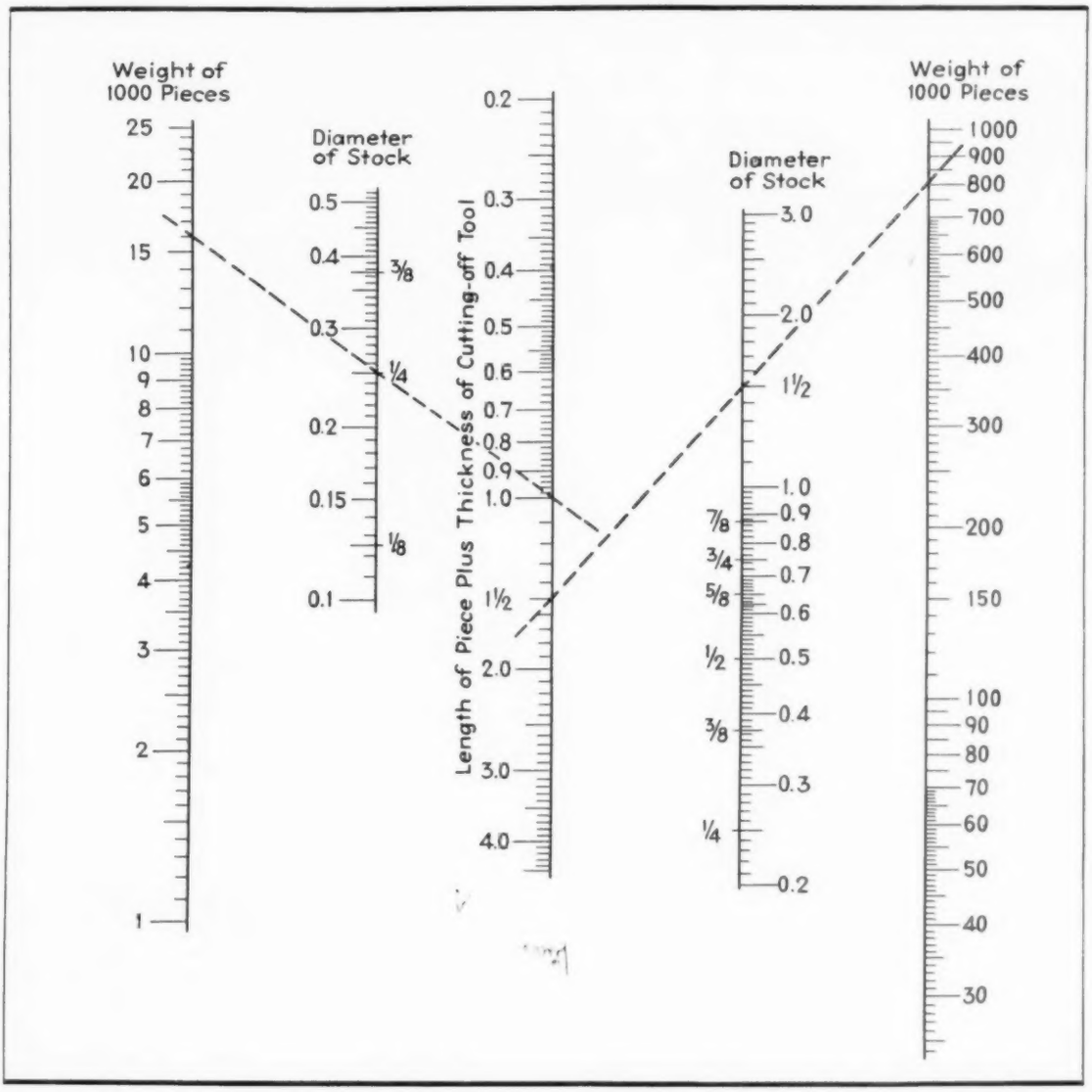
BY LOUIS de L. BERG

Hexagonal Steel and Round Brass

THIS CHART is used to determine the weight of hexagonal steel or round brass stock required for 1,000 pieces of known length and diameter within a range of approximately 0.10 in. diameter by 0.20 in. long to $1\frac{1}{2}$ in. diameter by 4 in. long. There are two diameter scales and two weight scales on the chart. Care must be taken that the weight scale is always read on the same side as the diameter scale.

DIRECTIONS—Ascertain the diameter of the stock to be machined and the length of the finished piece; add to the latter the width of the parting tool. Using this diameter and length, draw a line through the diameter and length scales until it intersects the weight scale. The reading on the latter will give the weight of hexagonal steel and round brass stock necessary to machine 1,000 pieces.

EXAMPLE—The weight of $1\frac{1}{2}$-in. hexagonal steel stock required for 1,000 pieces $1\frac{7}{16}$ long (add $\frac{1}{16}$ in. for width of the parting tool) is 820 lb. The weight of stock required for 1,000 pieces $\frac{3}{16}$ in. long made from $\frac{1}{4}$-in. round brass is 16 lb.



DEPENDABLE IN PERFORMANCE

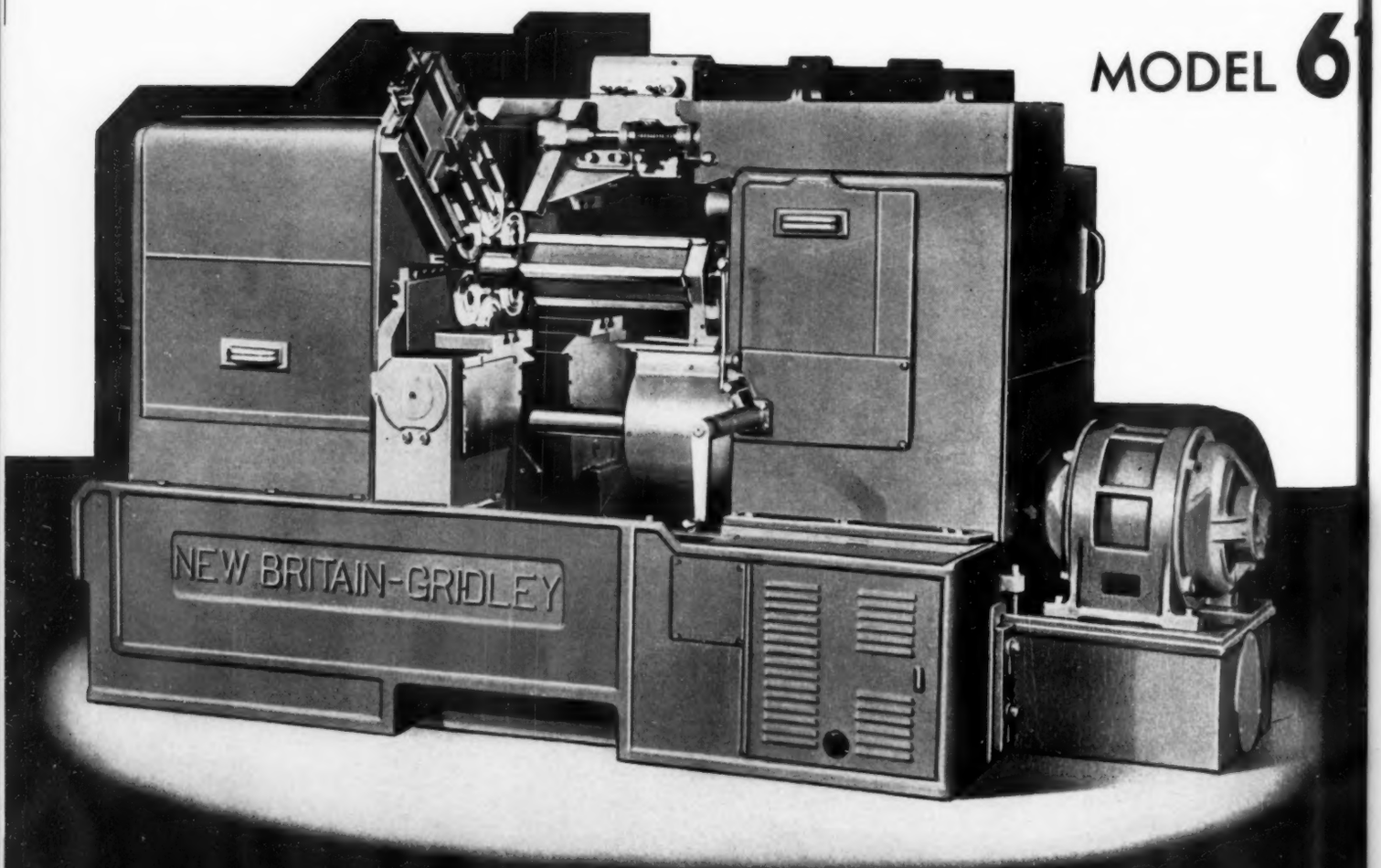
NEW BRITAIN Automatics have been engineered and developed to utilize the maximum efficiency of modern cutting tools by providing ample rigidity for the heaviest forming advances and anti-friction bearings throughout for the fastest speeds.

Extremely important, too, is that NEW BRITAIN Automatics maintain production while running at these top speeds,—through Exclusive Features such as Automatic Spindle Carrier Lifting and Clamping, forming Slides mounted on Circular Studs rigidly supported at both ends, with specially smooth bearing surfaces eliminating wear, Spherical Roller Collet Closing Devices, and many others,—all contributing to the outstanding performance of these modern Automatics on dependably accurate and continuous production.

NEW BRITAIN-GRIDLEY

MACHINE DIVISION • THE NEW BRITAIN MACHINE CO.

NEW BRITAIN, CONN.



A complete line of Screw Machines — Four and Six Spindles to 2¼" Capacity
Also a complete line of Chuckers — Four, Six and Eight Spindles to 10⅜" Capacity

Better Safe Than Sorry

MUCH TALK is floating around that the United States will not let the Allies lose the present war. The smug assumption is that if we should ever go in, Germany's case would be hopeless.

Perhaps this grand theory arises from a belief that all we would have to do would be to wave a magic wand and hundreds of thousands of guns, thousands of planes, dozens of new battleships and millions of trained men would suddenly spring from nowhere.

Close examination reveals this theory to be no closer to reality than a fairy tale. It just isn't so!

The Allies today don't need men. They need planes, and plenty of them. Yet a high governmental authority says that even if we should produce planes to full capacity for delivery to the British and French, they will not attain parity in the air with Germany until far into 1941.

What about such war goods as anti-aircraft guns, machine guns, shells, ammunition, mines? What about rifles, tanks, bombs, armor plate? The government knows only too well that these essentials of war cannot be produced overnight. If the Allies should be dependent upon quick delivery of these goods from us, heaven help them. And we are pitifully lacking in such equipment for our own defense.

For the truth is that the United States does not possess a munitions industry. Today we aren't much nearer having one than we were a year ago, despite what we have seen happen to inadequately armed countries around the world.

Yes, we have a sizable navy, but not one large enough in case the British should lose theirs. Battleships take years to build; our shipbuilding facilities are none too big. By the time our projected naval program is completed, international relationships may be different from today's.

If sentiment in this country some day should favor our going to the rescue of the Allies, should their course become desperate, they might easily lose the fight before we could get going.

Let's not deceive ourselves. For some unexplained reason we seem to think that the delays of the world war would not be repeated. Yet expert testimony from army officials has established the fact that U. S. industry would not be fully mobilized for war until fifteen months after a conflict began.

Don't forget that in our international relationships the past few years we have accumulated a choice group of hostile nations—Germany, Japan and Russia. In a world of victorious marching dictators, there are other ways than directly spanning three thousand miles of water to get at our interests. Shouldn't we be prepared for any such eventuality?

The least we can do to protect ourselves, let alone even seriously think about going to the aid of our fellow democracies, is to be partially prepared if not fully prepared. Economic power, billions of gold buried in the Kentucky hills, and a firm belief that our cause is just won't do us much good when guns and bombs and shells and airplanes and fighting equipment are required and we don't have them in sufficient quantities.

What we need is some semblance of a munitions industry. Surely an important segment of American industry should be thoroughly familiar with war-time manufacture. Our efforts thus far to educate industry for war production have been puny in the extreme. Any emphasis along military lines may be repugnant to our democratic ideas, but when there is possibility if not a probability of our being involved in war, the safest course is to take out insurance.

Burnham Finney

GAGING BUSINESS

How to produce enough machines to satisfy domestic and foreign demand continues chief machine tool problem. Aircraft engine makers start new expansion programs. Steel operations are up

With the tempo of Allied purchases and of U. S. national defense activities accelerating, the metalworking industry is in the midst of a rush period which is not likely to end so long as the war lasts. Demand for peace-time goods also is brisk.

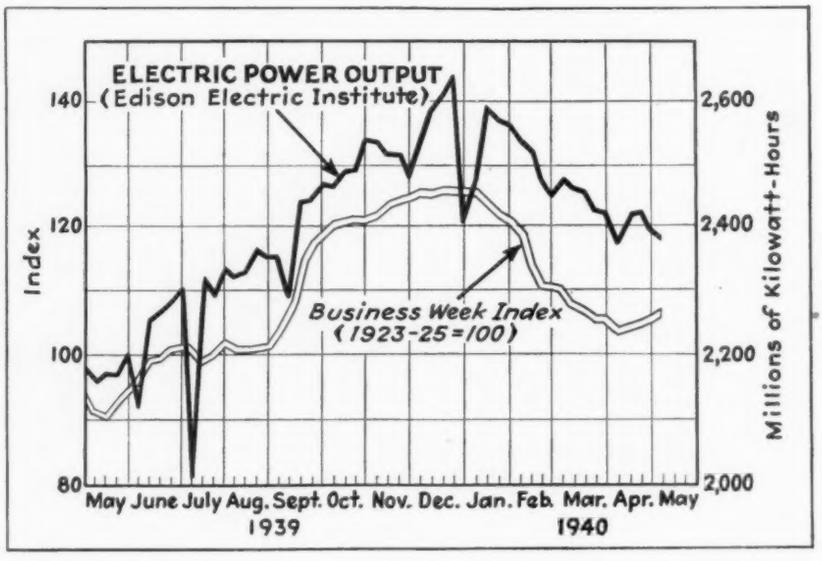
Machine Tools—How to produce enough machines to satisfy domestic and foreign customers continues to be the chief problem of machine tool builders. Greater output is being secured by adding modestly to plant capacities, by farming out manufacture of parts to outside firms and by lengthening working hours. Only a few companies are running entire factories three shifts. Difficulty in obtaining skilled help is one of the reasons why only two shifts are being operated by most builders. Aircraft engine makers now are formally placing orders against reservations made one to two months ago. Further purchases by aircraft companies are expected to be heavy. Domestic bookings from a variety of sources have been fairly good. Automotive buying in connection with tooling for the 1941 model season has been relatively light. A steady demand for equipment, particularly for shell turning machines, is reported from the Allies. Proposals are said to have been made by the British and French that U. S. machinery builders sign contracts for delivery of large numbers of tools through 1941. Such proposals, however, have not been accompanied by sufficient guarantees of acceptance and payment under changing conditions which might eventuate to result in any actual orders. Only a small amount of Russian and Japanese business is now on the books of machine tool makers.

Aircraft—Now that the Allies have placed verbal orders for planes and engines, presumably to be converted shortly into written contracts, airplane motor builders have finally launched sizable plant expansion programs over and above those started several months ago. Two companies (Pratt & Whitney Aircraft and Wright) are reported to have gone through two stages of tooling and factory enlargement and are at present in the third stage. One company benefiting handsomely from Allied purchases is Allison Division of General Motors. This company, however, is said to be a long way off from quantity production of its new engines. The aircraft industry as a whole is nearing its Spring mark of 80,000 employees, or double the number on its payrolls last fall. Backlogs continue at unprecedented heights. About 85 per cent of the industry's business is military and 15 per cent is required for commercial demands.

Steel—Export business mostly from non-belligerent countries cut off from their normal sources, and specifications against flat-rolled steel orders taken at recent low prices have stimulated steel production. Many sheet mills probably will operate close to full capacity the remainder of the second quarter. A letdown during the summer months, however, appears likely. Foreign bookings continue to be around 25 per cent of total sales of some mills.

Railroad Equipment—New York Central's order for 50 locomotives made April the best month of the year for locomotive builders. Freight car contracts, for 1,812 units, also put April at the top for the year to date. Pending business consists of 18 locomotives, 3,500 freight cars and 44 passenger cars. Orders on hand for freight cars are far greater than at the same time in 1939 or 1938. With carloadings running better than 600,000 per week, railroads are in the best shape in some time. South America is buying more and more railroad equipment in the United States as a result of the war. Full production of freight cars was resumed this week at the plant of the Mount Vernon Car Manufacturing Company, which has been closed since February 5 because of a strike.

Farm Equipment—Farm income in the first quarter was 12 per cent higher than a year ago, partly because of increased government subsidies. This improvement in purchasing power, which has been aided by rising prices the past few weeks, contributed to increased dealer sales of farm equipment during April. Some manufacturers now are working off inventories. Tractor sales are moderately good, while combine and hay machinery business is beginning to come in. Allis-Chalmers is expected soon to reach an agreement with the union. International Harvester is likely to appeal the ruling by Labor Board examiners that the company fostered labor unions at six plants and must cease allegedly unfair labor practices involving them.



Options Taken on 8,000 Planes by Allies

Contracts will soon be signed for 5,200 bombers and 2,800 pursuit ships for delivery within 18 months. Allison will supply 3,600 of 5,000 big engines now definitely lined up

WASHINGTON—Reason for all the confusion about what's in the $200,000,000 allied airplane order is that the estimators, quite literally, don't know what they're talking about. Actually the order is something of a fiction; no contracts have yet been signed. What has happened is that preliminary agreements have been made, but just about as binding commitments have been made on a great many more airplanes. When Chairman Purvis of the Allied Purchasing Commission announced the figure late last month he could just as well have used a larger or a smaller amount; more dollar figures will be announced at whatever seems the most politically propitious moment.

Options, of varying degrees of firmness, have been taken on 5,200 bombers and 2,800 pursuit ships for delivery in the next 18 months or so. The difference between the two types reflects the Allied weakness in long range equipment which was so graphically revealed in Norway. Engines for the airplanes are being bought separately because the commission is having to pay the cost of the plants to build its orders. About 5,000 engines (3,600 of them Allisons) have been definitely lined up, and more are implicit in the plant construction agreements being worked out with Allison, Pratt & Whitney, and Curtiss-Wright.

Of the medium bombers, it is known that Lockheed will build about 700, and 4,250 will be divided between Martin and Douglas, each producing at a rate of about 150 per month. Martin will fill its entire order, but Douglas will probably subcontract some to Boeing and Consolidated.

Bulk of the pursuits will be furnished by Curtiss-Wright, which is to build 1,500 P-40s; this order will be switched over to the more advanced P-40D as soon as this model gets into production. About 800 P-38s will be bought, but Lockheed, busy with bomber manufacture, will probably subcontract this entire order to its Vega subsidiary and to Vultee. Bell will furnish 200 Airocobras (P-39), and where the remaining 300 will come from is uncertain—perhaps Republic or Vultee or possibly Bell.

Orders are about ready to be signed (this is roughly equivalent to the announced $200,000,000) on the Curtiss and Bell ships, on 250 of the Douglas bombers, and on the engines. Contracts will incorporate very favorable cancellation clauses providing not only for all the manufacturer's out-of-pocket costs, including commitments to material suppliers, but also for the entire profit which the manufacturer would have made if the order had been completed.

TIME FUSES ORDERED

WASHINGTON—The War Department has awarded contracts for mechanical time fuses to the New Haven Clock Co. for $410,577; to the Waltham Watch Co. for $356,085 and to the Elgin National Watch Co. for $479,178. It also has contracted with the Western Cartridge Co. for cartridges, tracers and related items totaling $454,798.

War Activities Speed Defense Discussion in Congress

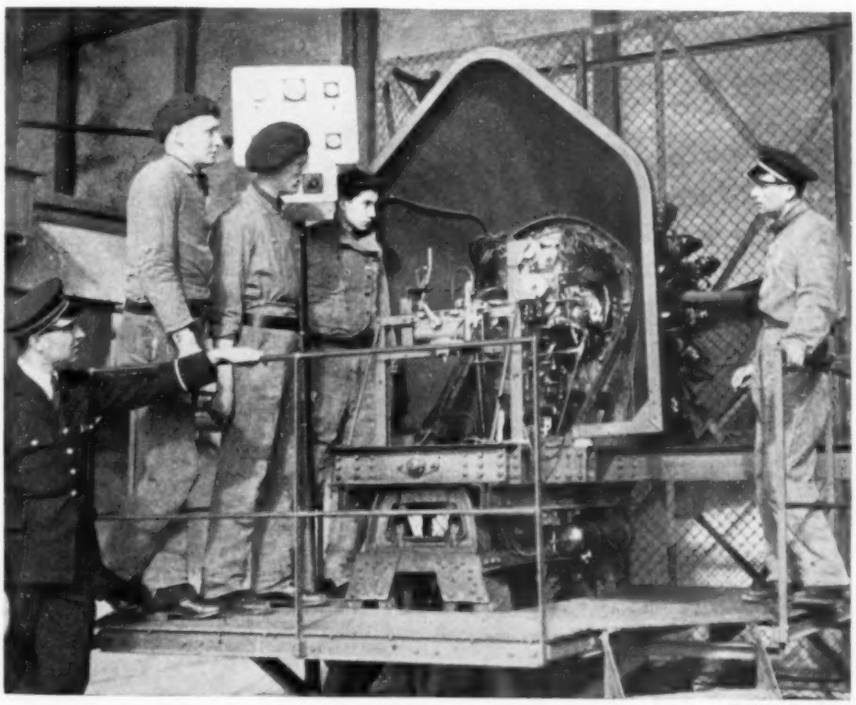
WASHINGTON—Defeat of the Allies in Norway perceptibly increased the tempo of war dance in Washington.

Congressmen are talking about a $500,000,000 to defend the Monroe Doctrine. Admiral Harold Stark, chief of Naval operations, announces he

Allies Have Spent Billion In United States Since Last Fall

NEW YORK—Approximately $650,000,000 has been spent in this country by the British and French purchasing commissions for airplanes, plane engines and materials, machinery and machine tools since the missions arrived in the United States last fall. In addition about $350,000,000 has been expended for such items as shell cases, fuses, clothing, trucks and raw materials.

These figures are being made public this week in an official statement by the commissions. Contract letting has materially expanded recently. This is evidenced by the fact that late in March the unofficial estimate of allied buying totaled $600,000,000. Apparently some $400,000,000 has been contracted for during the past several weeks.



British Combine

Future French Mechanics—*The French recognize the importance of plane maintenance as well as that of production. Here, in the technical school of the air, apprentices are taught the fine points of engine repair*

will ask that the Navy begin work on completion of the 299,635 un-built but authorized tonnage. Senate Naval Affairs Chairman David I. Walsh decided to re-open hearings on the $655,000,000 naval expansion authorization bill.

Chairman Elmer Thomas, of Senate Military Appropriations subcommittee is concerned about the House cut in the 1941 supply bill to only 57 replacement planes for the Army, and says the committee may be moved to add $20,000,000 for purchase of 106 latest type ships with parts and additional services that would be necessary.

The Bureau of Budget notified the Senate Appropriations Committee it has approved an additional $13,000,000 plus $5,000,000 contract authority for Army Ordnance and Signal Corps supplies, to be included in the 1941 Army supply appropriation, which the House passed at $784,999,000. Part of the new money would go for anti-aircraft equipment.

Brigadier General George Strong, star strategist, urged Army preparation to "out-blitz any blitzkrieg" in this hemisphere, and preparation to aid the Allies if their territorial integrity is threatened. He said the Army lacks $500,000,000 worth of critical materials for the Protective Mobilization Force of 1,000,000 men.

Meanwhile President Roosevelt said any additional appropriations for munitions would be useless because production is near the maximum now, and that he will ask for no more defense funds this session.

Canadian Plants Being Taxed To Capacity by War Orders

MONTREAL—Orders from the British as well as the Canadian government are taxing present Canadian manufacturing facilities to capacity. This is especially true of airplane plants.

Canadian Car & Foundry Co. is planning to add new equipment at its Fort William, Ont., plant, and to inaugurate airplane parts production at its Amherst, N. S., plant, where hitherto only railway cars have been made.

Davie Shipbuilding & Repairing Co., Ltd., subsidiary of Canadian Steamship Lines, Ltd., has sufficient business on its books to keep its plant at Lauzon, near Quebec City, busy for the next 18 months, without taking any further business. At present, the British Shipping Office is negotiating with Davie for construction of ocean patrol boats.

John Inglis Co., Ltd., has received a substantial additional order for Bren machine gun parts from the British War Office. Work on the first order—7,000 guns for the Canadian government and 5,000 for Britain—is now five months ahead of schedule.

"Design for Living in America" Offered by Ralph Flanders at SAE Production Meeting

New machine finishes, aircraft production problems, abrasives and cutting oils were topics discussed at technical sessions

HARTFORD—Upon increased production in this country depends solution of unemployment, declared Ralph Flanders, president Jones & Lamson Machine Co., in addressing the national production meeting of the Society of Automotive Engineers at Hartford, Conn., May 7-8.

Every governmental policy, asserted Mr. Flanders, should be tested by asking the question: "Will it increase the production of goods and services in the nation?" If the answer is "no," the reasons for the policy will have to be extraordinary to warrant adoption. If it is "yes," objections must be serious to warrant rejection.

Mr. Flanders presented in detail a "design for living in America" which business has the opportunity to accept and sell to the people and through them to the government. He stressed the need for government to guarantee to everyone basic subsistence by furnishing employment when private employment fails. Government program for such employment should be capable of rapid expansion and contraction to match the expansion and contraction of unemployment. If such a process is well managed by an administrator whose primary purpose is the revival of private production and distribution, "why should business be afraid of the maintenance of its consumer market–" inquired Mr. Flanders.

Technical sessions were built around three topics: new machine finishes, aircraft production and abrasives. In his discussion of special problems in aircraft engine production, Val Cronstedt, research engineer Pratt & Whitney Aircraft Division, United Aircraft Corp., pointed out that stability of design is not yet within sight. Design changes, in fact, are likely to be larger in number in the future.

A new study of cutting fluid recommendations was made public in a paper prepared by H. L. Moir, Pure Oil Co., and Professor O. W. Boston, University of Michigan.

Edwin R. Smith, vice-president Seneca Falls Machine Co. and production vice-president of the S.A.E., presided at the dinner meeting and at the abrasives session. Howard Dunbar, vice-president Norton Co., was in charge of the aircraft production session, and Joseph Geschelin, *Automotive Industries*, of the new machine finishes session.

Exports of Machinery During March, 1940

	March 1940	February 1940	March 1939
Electrical machinery	$10,335,418	$9,253,949	$9,329,934
Power generating machinery except automotive and electrical	2,119,230	1,805,935	2,099,629
Construction and conveying machinery	3,223,837	1,983,992	1,827,541
Mining, well and pumping machinery	5,245,434	4,147,897	6,259,655
Power driven, metal-working machinery	18,267,473	13,691,528	12,057,012
Other metal-working machinery	922,889	652,745	344,327
Textile machinery	1,233,464	1,289,368	831,194

Metal-Working Machinery

Engine lathes	$1,290,669	$1,103,333	$662,379
Turret lathes	1,432,524	923,340	468,017
Other lathes	643,324	390,597	219,137
Vertical boring mills and chucking machines	797,520	912,798	713,161
Thread cutting and automatic screw machines	1,761,598	1,179,178	313,067
Knee and column type milling machines	740,759	632,397	840,717
Other milling machines	1,185,203	1,273,049	1,584,536
Gear cutting machines	735,039	435,265	486,165
Vertical drilling machines	329,164	154,914	134,914
Radial drilling machines	289,428	88,303	114,067
Other drilling machines	350,760	176,641	407,601
Planers and shapers	473,904	218,962	379,707
Surface grinding machines	550,668	272,731	364,562
External cylindrical grinding machines	379,553	609,286	380,154
Internal grinding machines	920,403	463,329	380,803
Tool grinding, cutter grinding, and universal grinding machines	856,532	382,093	270,747
Other metal-grinding machines and parts	845,701	686,829	611,258
Sheet and plate metal-working machines and parts	543,580	618,487	374,495
Forging machinery and parts	805,763	398,703	615,961
Rolling mill machinery and parts	1,414,317	852,075	1,619,110
Molding machines	45,377	37,004	46,269
Other foundry equipment and parts	110,336	67,127	50,562
Other power-driven metal-working machinery and parts	1,765,351	1,815,087	1,019,623
Pneumatic portable tools	466,856	195,052	101,790
Other portable and hand or foot-operated metal-working machines and parts	150,283	153,371	92,867
Chucks for machine tools	38,717	26,647	27,426
Milling cutters, machine-operated threading dies, and taps and similar machine operated metal cutting tools	88,336	139,364	67,412
Other metal-working machine tools and parts	158,697	138,311	54,832

INSIDE DETROIT

Wider, lower and more comfortable bodies will feature 1941 models. Announcements to be early this year. Production is lower, but some makers will equal April's output

BY RUPERT LE GRAND, DETROIT EDITOR

DETROIT—Despite beliefs in parts of the country that announcement of 1941 models will come considerably earlier this fall, it is understood that much the same pattern will be followed this year as last. Possibly the majority of manufacturers will be ready to show their new wider, lower and more comfortable creations about the middle of September, averaging a week or so earlier than last year. But the New York Automobile Show is a week earlier, too.

Major producers like Pontiac, Oldsmobile, Buick and certain Chrysler divisions will probably wind up current models about the first or second week in July. Assembly lines will not get under way again for four to five weeks. Another 30 days will be needed to stock dealers before announcement. Chevrolet and Ford will probably not go down until August, because it is their custom to announce new models only a week or two before show time. Some of the independents will probably again hit the market early in an attempt to make a good sales start while competition is not severe.

There are a number of reasons for maintaining the usual state of affairs: (1) Sales are good and the outlook continues favorable; (2) it is desirable to make as many models as possible from present tools in order to reduce the cost per unit; (3) large body plants are physically unable to cope with "overnight" changeovers, especially when a large number of details are to be changed, as in the 1941 models. There have been occasions when changeovers have been handled in ten days, but that rare occurrence took place in the days when very little was done to body styling and dimensions.

Continue Work on Ford Six

For a long time it has appeared that the Ford six-cylinder engine (OMA model) would be cancelled, but work is now going forward on rebuilding fixtures for a longer block. Apparently it has been decided to increase the bore and stroke. This engine would feature steel cylinder liners, which are supplied in almost all of current Ford production as well as Mercury engines.

The fact that the project was not killed off is no guarantee that the six will be included in the 1941 line. Company sources point to Edsel Ford's testimony before the TNEC in reference to the undesirability of upsetting the used-car market by offering a car in the $500 price class. Whether such an engine could be offered, or is intended, for that field is doubtful because the original conception of the motor was for a design that would have a maximum of quality features, including overhead valves operated by an overhead camshaft. It is also said that the design is "too green" to permit use of the six in 1941. Yet the fact remains that much machinery will be available, plus revised tooling, for a start on the six this summer if the company elects to put it on the market in the fall.

MARTIN RESIGNS UNION POST

DETROIT—Homer Martin resigned late last month as president of the A.F.L. United Automobile Workers. His retirement will become effective June 1. No announcement has been made regarding his successor.

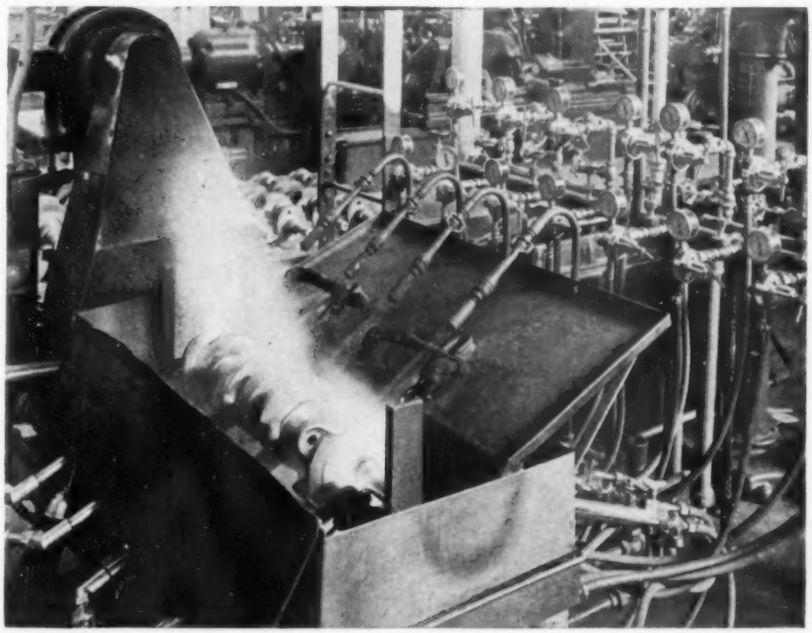
The factional struggle between the AFL and CIO, which shoved Mr. Martin back to comparative obscurity, reached an anti-climax last month when General Motors Corp. employee elections designated the UAW-CIO as bargaining agency in 48 plants and the UAW-AFL in only five plants.

No Alarm Over Less Production

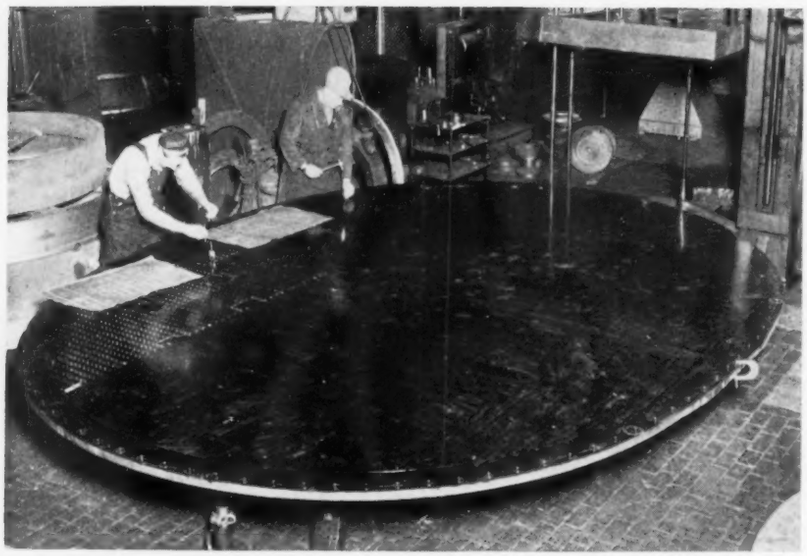
Automobile production began to slip during the latter part of April, with the result that output for the month reached 447,400 units, as compared to an earlier forecast of 465,000. The loss was mostly accounted for by reversion to the four-day week by Ford and Dodge, and by slight cuts by other makers.

May production will fall substantially below that of April, and is likely to be in the neighborhood of 400,000 units. Even so, that figure is considerably better than the 313,214 units assembled in May, 1939.

There is no reason for alarm over declining production. The industry produced 1,757,645 units during the first four months of 1940 as compared with 1,418,219 a year previously, or a gain of 24 per cent. Sales by most producers have been strong since the beginning of the year, and April appears to have outstripped March by a slight margin. With ample field stocks and the prospect of sales declining as the spring bulge is passed, there is reason to trim production during May by possibly 10 per cent, and in June by a further 15 per cent. The problem now confronting planning departments is that of balancing remaining production against probable sales and



Peacetime Flame Thrower—*Built by Lincoln Motor engineers, this automatic machine flame hardens main bearing surfaces of 85-lb. Zephyr cast-steel crankshafts. Torch and quenching jets are controlled by cams*



5,560 Holes—*In this 13 x 16-ft. plate of Munz metal (60 per cent copper and 40 per cent zinc) will be drilled 5,560 one-inch holes. Plate is one of two to be used in assembly of a 35,000-sq.ft. surface condenser*

field stocks before new-model announcement, so that dealers are not left with large stocks.

Sales Continue Strong

Encouraged by strong sales in April, motor car manufacturers are doing their utmost to maintain volume during May by field trips, dealer meetings and drives to demonstrate 1940 models to bona fide prospects. Certain makers report satisfactory conditions in the used car market. But heavily stocked lots are in evidence in Detroit, and "sales allowances" are getting longer. Nevertheless, dealers have had a good year. On this subject, Pontiac says that its dealer organization has netted 110 per cent more in the first three months of 1940 than in the same period of 1939.

Among General Motors Divisions reporting April sales, Chevrolet exceeded March by approximately 2,000 cars and trucks, delivering 108,362 units. Pontiac gained 1,040 units, achieving an April total of 22,741. Buick romped home with a 17.4 per cent gain, finishing the month with 28,652.

Nash found sales strengthening during the closing ten days of April, and says that sales for the model year are up 26 per cent as compared with the 1939 model. April so encouraged De Soto that it plans to attain 500,000 demonstrations to hot prospects in May.

Welded Frames Are Coming

Chassis engineers and frame makers are interested in substituting resistance welding for riveting and arc welding in frame manufacture. Objects: lower cost and greater strength. Steps toward full-resistance welded frame will be slow, since many of the production problems will require much shop experimenting. Yet one important engineer has remarked that the welded frame is coming and that the manufacturer who does not use it will be behind the eight ball on competitive costs.

DIES FARMED TO AVOID TROUBLE

DETROIT—Word is that car makers have purposely farmed out a lot of their tool and die work in order to keep the number of toolmakers on any one project to a minimum, thereby preventing loss or delay of vital material through an attempt by labor to tie them up with demands. Previous explanation was that there is too much tool and die work for the home shops.

Further Business Complications Seen In New Illinois Tax

CHICAGO—When the Supreme Court on Jan. 29 by a vote of 5 to 3 said in effect that taxes on material shipped into New York were subject to that state's sales tax and that such taxes were legal as long as they put no undue burden on interstate commerce, it left the way open for Illinois to apply the same principles under its retailers occupation tax. While the Department of Finance is reserving the right to pass on each specific question regarding interstate commerce, it has expressed its opinion on certain principles which in effect mean that every sale of machinery in the state will be taxed three per cent regardless of F. O. B. point. Apparently the only exemption at this time is on sales in which there is a completely mail order transaction and on which no commission is paid in Illinois.

Opinions differ on the correctness of these rulings, and M.A.P.I. has issued a memo indicating that if title is transferred outside the state and possession taken by the buyer at that point no tax need be paid. Solution to the problem will require a test which so far has not been started. This case may arise first in the coal industry, where Illinois mining companies have been particularly affected because out-of-state coal concerns have not had to pay the tax.

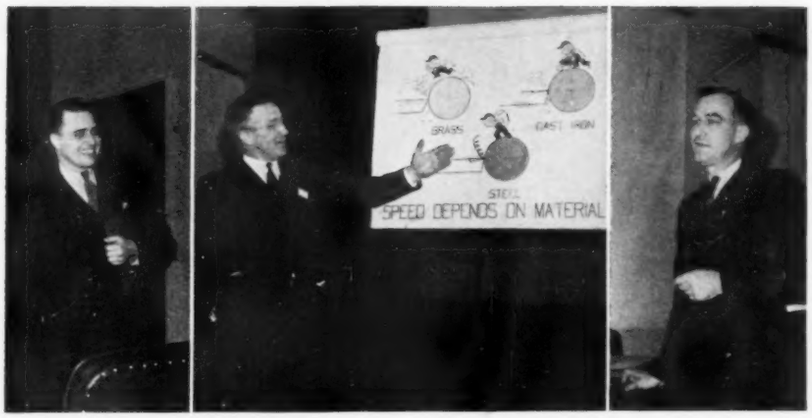
What meaning this may have for the metal-working industry is open to question. There is no doubt that within the state it puts the Illinois manufacturers in equal bargaining position with out-of-state manufacturers since neither will have to pay the tax. However, there is some doubt that this will be of any importance inasmuch as the freight for out-of-state manufacturers compensated for the tax which had to be paid by local manufacturers. So far as can be determined the ruling will have no effect on sales, with the exception that the Illinois ruling which was released on March 15 became effective April 1, except as to receipts under any agreement made before Jan. 29. Since machine tools, for example, require comparatively long periods for manufacture, there may be some adverse effect on those contracts made between Jan. 29 and March 15, when the ruling first appeared. Of course, from the long-range view-point this is another step backward in the struggle between the states.

British Representative Looks For Cemented-Carbide Supply

NEW YORK—Arthur H. Alexander, member of the firm of George H. Alexander Machinery, Ltd., Birmingham, England, is in the United States arranging for an increased supply of cemented tungsten titanium carbide for machining tough alloy steels. His firm, manufacturers and importers of machine tools and small tools, is licensed in England to manufacture and sell Kennametal, the carbide developed by the McKenna Metals Co.

J. ROY PORTER HONORED

CHICAGO—J. Roy Porter, since 1928 president Marshall & Huschart Machinery Co., Chicago, Ill., was elected chairman of the board at a banquet honoring his 50 years of service to the machine tool industry. George Habicht has been elected president and general manager, while C. P. Stollstorff has been named secretary, succeeding Frank Seese.



Speakers *at the Westinghouse Machine Tool Electrification Forum included, from left, John C. Wilson, Thompson Grinder Co.; W. K. Bailey, Warner & Swasey Co.; R. W. Owens, Westinghouse Electric & Mfg. Co.*

Machine Design and Control Problems Discussed at Fifth Annual Forum

PITTSBURGH—More than 125 representatives of about 75 machine tool builders and major users met at the East Pittsburgh plant of the Westinghouse Electric & Mfg. Co. May 6–8, to discuss mutual electrification and design problems with Westinghouse engineers in a series of open-forum meetings. This was the fifth annual forum of this nature sponsored by Westinghouse, and drew the largest attendance thus far.

Bernard Lester, special representative of Westinghouse, outlined possible future trends in machine tool development. He pointed out that, with continued reductions in daily working hours and increasing cost of machine operator's time, the efforts of the machine tool designer must be bent to increase further the efficiency of the machine itself, particularly a reduction of time in setting up operations.

He also pointed out that it is necessary now to make the machine more adaptable to man, rather than to expect the man to adapt himself to the machine. This means a study of natural and agreeable motions of working men. Machines must be made more convenient, quiet and free from vibration. Another point made by Mr. Lester was the possibility of increased use of "tell-tale" or recording and indicating devices to tell at a glance what the machine actually is doing.

Operator Training a Problem

Indicative of the problem now faced by practically all metal-working plants in selecting and training operators was the interest shown in papers presented Tuesday afternoon by W. K. Bailey, sales manager Warner & Swasey Co., and C. D. Moore, trades training supervisor for Westinghouse.

Mr. Bailey pointed out that most shop managements continually are trying to hire better men but that little is done to improve the ability and interest of men already at work. He called attention to the fact that even with the present increased interest in training programs there probably will not be enough skilled men available to operate the machine tools now being produced for use in the United States.

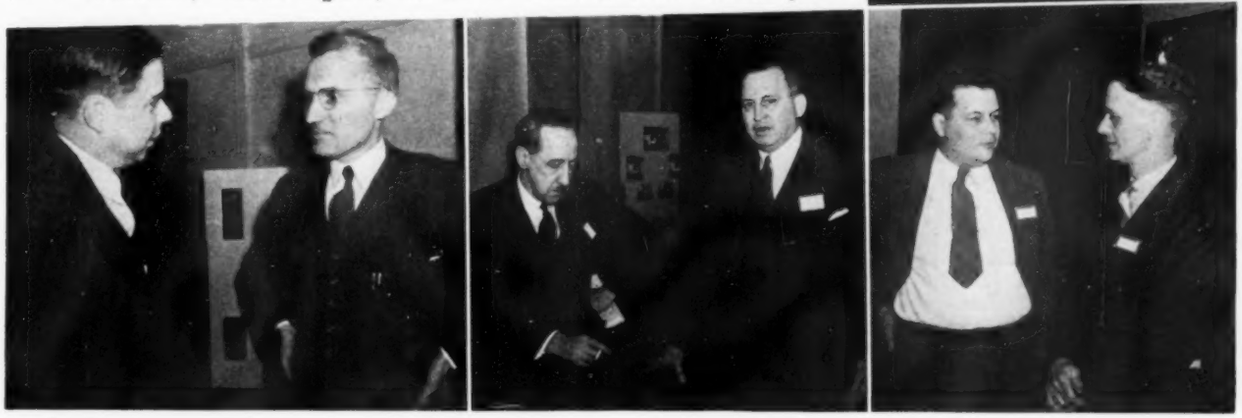
Mr. Moore said that the interview still is considered the most important part of the selection program, but that this can be supplemented to advantage by using mechanical aptitude, general knowledge and mathematical tests worked out to suit conditions in a given plant.

Open Forums Featured

A number of papers were presented by engineers employed by machine tool builders. Among these were J. C. Wilson, mechanical engineer Thompson Grinder Co.; R. S. Elberty, electrical engineer Landis Tool Co.; D. K. Frost, electrical engineer Mattison Machine Works; and A. H. Platt, electrical engineer The Bullard Company.

Wednesday afternoon was given over to an open forum on problems not covered by the program, particularly to a discussion of possible wiring standards for the machine tool industry, and to tours through different sections of the Westinghouse East Pittsburgh and Nuttall works.

Talking things over, *below, are Louis W. Weber, Lodge & Shipley, and C. D. Moore of Westinghouse; W. P. Beattie, American Laundry Machinery, and L. Lee Schauer of Cincinnati Bickford; and W. F. Ridgway, Ingersoll Milling Machine, and A. H. Platt of Bullard. At right are A. P. Witteman, Leland Gifford, and A. L. Krause, Brown & Sharpe*



WATCHING WASHINGTON

Basic changes in battleship construction advocated as protection against airplanes and submarines. Wage-hour amendments shelved. Garand rifle passes Army tests

BY BLAINE STUBBLEFIELD

WASHINGTON — Navy Secretary Charles Edison, just back from the Pacific war games, called the press in, and told them what he thought: that airplanes have a "temporary" advantage over war ships; that ships now in service and building should have their decks cleared of objects which will splinter when bombed, destroying personnel; fire and navigation controls on the topside should be put below or protected so that aerial attack cannot disrupt operations; new construction should be "basically" changed on the topside.

Against underwater attack, with modern submarines and mines, the Secretary said he would recommend heavying the side armor to protect the bottoms, all of which are too thin, and he would thicken the bottoms of new construction. He said of course that all this armor, top and bottom, must compromise with weight and speed. He emphasized his doubt that airplanes can sink battleships.

Meanwhile *The Aeroplane*, an authoritative British aviation magazine, bluntly states that bombing planes, soon or late, will prove superior to warships. This opinion is grimly significant, with England staking her fate on sea power. The article says the old battle between projectile and armor is thus continued, with the shots coming from overhead. Right now, navy armor has the advantage, but more-destructive bombs are surely coming, it says.

Diesel Engine Unlikely for Big Planes

Military interest in Guiberson's diesel engine for airplanes (AM, May 1, page 306g), though pronounced, is rather academic since the Guiberson is a small power plant only suited to civil aircraft. Eventual military value of diesels is not ruled out however as the range of bombers increases. Somewhere in the neighborhood of a 24-hour cruising range the total weight of fuel and engine becomes less for a diesel than for a gasoline power plant. Horsepower for horsepower, diesel has about as good performance characteristics except for the vibration, and it is possible to design around that by cushioning the propeller. The critical range is beyond the performance of present bombers, so no Army or Navy craft is now diesel-powered. Perhaps the new 70-ton Douglas bomber and the 85-ton ship Martin is supposed to be building for the Navy exceed the critical range, but diesels were not even considered for them because none now builds light-weight high-speed diesels in the upper horsepower brackets. Looking forward to even bigger ships, however, the Navy Bureau of Aeronautics is now carrying on an ultra-secret program of research in cooperation with the Army Air Corps.

Court Decision Affects All Labor

The Supreme Court decision in the Walsh-Healey case is important enough to the steel industry—involving immediate pay raises for some 15,000 common laborers, probable eventual pay adjustments for as many as 200,000 semi-skilled and skilled workers, and destruction of little steel's wage differential with big steel—but it goes beyond steel to effect every industry which sells to the government. It goes far beyond the question of the meaning of "locality." In essence, Justice Black's opinion held that to bid on government orders is a privilege rather than a right and that Congressional determination of conditions for government purchases is not in law (whatever it may be in fact) regulation of business. It follows that a seller aggrieved by the manner in which the government does its buying has no standing in court. In particular, when Congress leaves certain points (in this case the delimitation of the locality within which wages shall be said to prevail) to the discretion of the Secretary of Labor or other officer, only Congress can control the manner in which that discretion shall be exercised, and the courts have nothing to say about it.

MAY CHANGE NAVY SET-UP

Action is expected this session on a bill incorporating Secretary Edison's plan for reorganization of the Navy Department. The plan would abolish the Bureau of Construction and Repair and the Bureau of Engineering and set up in their place a Bureau of Ships, which alone would be responsible for shipbuilding. The Bureau of Ships would be headed by a chief to be appointed by the President and confirmed by the Senate. He would be a Naval officer with special experience in naval architecture. The reorganization, supported by the Administration, is expected to increase efficiency, reduce costs, and eliminate mistakes such as the top-heavy destroyers.

No Amendments for Wage-Hour Law

All proposed amendments to the Wage-Hour law were killed dead as Hector by the House last fortnight when it rejected the Barden bill and re-committed the Norton bill without recommendations. There will be no more changes attempted this session of Congress. Only item of interest to metal working was proposed exemption of salaried workers from hours regulation—in both bills. This will come up again next year.

Contracts Soon For Submarine Nets

Congress turned the Navy down on its request for $22,000,000 to keep submarines out of strategic harbors with nets, and only $2,000,000 was provided. But it takes 18 months to fabricate the nets, so Navy is going ahead getting bids on chains, buoys, anchors, and such to be ready to let contracts soon as they get the money. Specifications of the nets, which will be fabricated at the Mare Island Navy Yard, are very hush-hush, so much so that the bid calls on materials will be buried in other supply orders rather than issued all together.

Tests Prove Garand Efficiency

Trouble with Garand automatic rifles was talked about by military and civilian experts till Congress forced the Army to prove its case. It takes this position: The Garand is the best available, all things considered. If the rifle invented by Melvin Johnson, a retired Marine Reserve Captain, or any other, is better in some ways it is not enough to justify a change. Mass production, standardization, are highly important in equipping an army. Fort Belvoir tests of the Garand and Johnson rifles have convinced a score of members of Senate and House Military Affairs and Appropriations Committees that "both are mighty fine guns." Congressmen indicated there will be no interference with Garand production. No tests were made over 600 yards; Army officers say that that distance is the practical range limit.

SALES

ARCHIE CHANDLER has been elected vice-president in charge of sales, American Pulley Co., Philadelphia, Pa.

R. F. HEATH has been transferred from the Houston territory to the New Orleans territory of Manning, Maxwell & Moore, Inc., Bridgeport, Conn.

G. E. HUNT has been placed in charge of the Indianapolis, Ind., office of Cutler-Hammer, Inc., Milwaukee, Wis.

BOB KOCH has been appointed manager of the new Houston, Texas, branch office of Morse Chain Co., Ithaca, N. Y.

GEORGE P. NEEDHAM has been appointed Ohio representative for Cowles Detergent Co., Cleveland, Ohio.

J. A. ST. CLAIR has been named chief sales engineer, Industrial Div., E. C. Atkins & Co., Indianapolis, Ind.

WILSON K. WINBIGLER has been placed in charge of the new Baltimore, Md., office of Ward Leonard Electric Co., Mount Vernon, N. Y.

MEETINGS

AMERICAN GEAR MANUFACTURERS ASSOCIATION. Annual convention, Grove Park Inn., Asheville, N. C., May 20–22.

AMERICAN IRON & STEEL INSTITUTE. Forty-ninth general meeting, Hotel Waldorf-Astoria, New York, N. Y., May 23.

AMERICAN MANAGEMENT ASSOCIATION. Production conference, Hotel Pennsylvania, New York, N. Y., May 22 and 23.

AMERICAN SOCIETY FOR TESTING MATERIALS. Annual meeting, Chalfonte-Haddon Hall, Atlantic City, N. J., June 24–28.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY. Special summer conference on friction and surface finish, Cambridge, Mass., June 5–7.

NATIONAL METAL TRADES ASSOCIATION. Forty-second annual convention, Biltmore Hotel, New York, N. Y., May 21 and 22.

SOCIETY OF AUTOMOTIVE ENGINEERS. Summer meeting, The Greenbrier, White Sulphur Springs, W. Va., June 9–14.

New A.S.T.E. Chapter Chartered—*A. H. d'Arcambal, American Society of Tool Engineers president, presents the charter for Greater New York Chapter to Andy Duncan, E. W. Bliss Co., who was elected chairman at the organization meeting held May 8 in Brooklyn, N. Y. Other officers are Thomas Orchard, Herbert D. Hall Co., vice-chairman; H. L. Horton,* Machinery, *secretary; and A. J. Schwister, Greenfield Tap & Die Corp., treasurer*

NAMES in the NEWS

JOHN P. MCWILLIAMS, president Youngstown Steel Door Co., and NEWELL C. BOLTON, Cleveland, Ohio, have been elected directors of Youngstown Sheet & Tube Co., succeeding the late H. C. DALTON and GEORGE BISHOP, retired.

HERBERT MORLEY has been appointed plant manager for all Detroit manufacturing units of Norge Div. of Borg-Warner Corp., Detroit, Mich.

Mr. Morley left the Canadian Products Div. of General Motors of Canada in 1923, to take over the operation of Detroit Gear & Machine Co., and later to form the Norge organization. He has since been in charge of engineering, research and manufacturing for the company's divisions in Detroit and Muskegon.

FRANK J. SCHUMAN has been appointed works manager of Federal Machine & Welder Co., Warren, Ohio. CHARLES J. MARTIN has been named chief engineer. Prior to joining Federal Machine & Welder, Mr. Schuman was associated with the Standard Tube Co., Detroit, Mich., as works manager, and with the S. R. Dresser Mfg. Co., Bradford, Pa., as plant superintendent. Mr. Martin was assistant chief engineer of Ford Motor Co. from 1923 to 1934, having had charge of the design of all production equipment. From 1934 to 1940 he was affiliated with Ex-Cell-O Corp., Detroit, Mich., as machinery salesman and sales engineer.

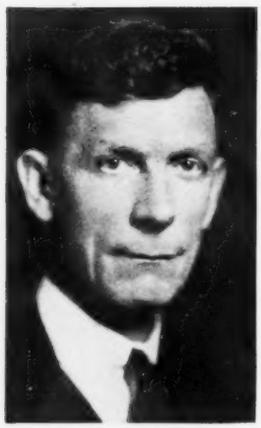
HERBERT MORLEY

FRANK J. SCHUMAN

CHARLES J. MARTIN

M. F. MCCONNELL

J. W. KINNEAR, JR.



H. G. MCILVRIED

L. S. DAHL

MALCOLM F. MCCONNELL has been named manager of technical developments, Carnegie-Illinois Steel Corp., Pittsburgh, Pa. JAMES W. KINNEAR, JR., has been appointed assistant manager of operations, Pittsburgh district; HOWARD G. MCILVRIED has been appointed general superintendent at Homestead; and LAWRENCE S. DAHL has been named general superintendent of the Irvin Works.

Mr. McConnell, who has been associated with subsidiaries of U. S. Steel since 1905, has been general superintendent of the Homestead works since 1933. He had previously been general superintendent at the Mingo Junction, Ohio, works of the former Carnegie Steel Co.

Mr. Kinnear joined Carnegie Steel Co. at Homestead in 1923. He was appointed assistant superintendent of an open hearth department there in 1938, and assistant chief metallurgist in 1932. He has been assistant general superintendent at Homestead since 1937.

Mr. McIlvried, general superintendent of the Irvin works since its construction in 1938, has been associated with U. S. Steel since 1902. He held various engineering positions with the former American Sheet & Tin Plate Co., and was chief engineer of that firm from 1931 to 1933. He was appointed assistant manager of operations, Chicago district, of Carnegie-Illinois in 1936, coming to Pittsburgh a year later during the construction of the Irvin works.

Mr. Dahl became associated with subsidiaries of U. S. Steel Corp. at Gary, Ind., in 1927. He succeeded to various operating positions at Gary, becoming superintendent of the hot strip mills in 1936. He was named assistant general superintendent of the new Irvin works in 1937.

S. C. ALLYN, former vice-president and general manager of National Cash Register Co., Dayton, Ohio, and associated with the company since 1913, has been elected president. He succeeds COL. EDWARD A. DEEDS, who will continue as chairman of the board.

O. L. BARD, for the past seventeen years secretary Michigan Tool Co., Detroit, Mich., has been elected president and treasurer. MARVIN R. ANDERSON, five years with the company, was named vice-president, while ARVID LUNDELL has been made secretary.

T. B. DANCKWORTT, president Danckwortt Diesel Engineering Co., Balboa, Calif., maker of "Daco" light-weight diesel engines, is planning to visit the East and Middle West in June.

G. R. HAWORTH has been appointed general superintendent, Western Maryland Railroad Co., Baltimore, Md., to succeed the late ARTHUR WILLIAMSON.

EDWARD L. RYERSON, JR., has been elected chairman of Inland Steel Co., Chicago, Ill., following the retirement of L. E. BLOCK, who has been made chairman of the executive committee.

E. S. CHAPMAN has been elected vice-president in charge of production, Plymouth Div., Chrysler Corp., Detroit, Mich., succeeding the late P. C. SAUERBREY. A. H. PATERSON, former factory manager, has been appointed to succeed Mr. Chapman as general works manager.

Mr. Chapman first joined Chrysler Corp. in 1928, after thirteen years in the machine tool industry. Since that time he has served as staff master mechanic for K. T. KELLER, assistant operating manager of the Highland Park plant, and operating manager of the New Castle, Ind., plant. He was later assigned to the organization of the Amplex Div., which developed the "Oilite" bearing. In 1935, he joined the Plymouth Div. as general works manager.

Mr. Paterson joined the original Dodge Bros. organization in 1913, before that company had begun the manufacture of automobiles. For the next year, he helped build the original Dodge, and when production got under way served as night general foreman. He advanced rapidly through the shop, from foreman to time study department, master mechanics division, body engineering department, accounting department and purchasing department. In 1928 he left Dodge with Mr. Sauerbrey to supervise construction of the present Plymouth plant and become factory manager, the position he held until the present.

E. S. CHAPMAN

A. H. PATERSON

EUGENE EDWARD WILSON, senior vice-president United Aircraft Corp., New York, N. Y., has been elected president, succeeding the late DONALD L. BROWN. RAYCROFT WALSH, former general manager of the Hamilton Standard Propellers Div., has been named vice-president.

Mr. Wilson was born in Dayton, Washington, and graduated from the United States Naval Academy in 1908. During subsequent naval service, he played an important part in developing air-cooled radial engines, serving as chief of the engine section of the Bureau of Aeronautics from 1924 to 1926 and as chief of the design section from 1926 to 1927. In 1930 he resigned from the Navy to become president of Hamilton Standard Propeller Corp., then a subsidiary of United Aircraft. Later he became president of Sikorsky Aircraft Corp., another subsidiary, and still later president of a third subsidiary, Chance Vought Corp. Since 1937 he has been senior vice-president of United Aircraft.

Mr. Walsh was born in Boston, Mass., and studied engineering at Massachusetts Institute of Technology and Columbia University. In 1910, while still a student, he was commissioned a Second Lieutenant in the Coast Artillery Corps of the regular Army. In 1917 he received the rating of Airplane Pilot and was transferred to the Air Corps. In 1926, when he was chief fiscal officer of the Air Corps, he resigned to enter business and for two years was associated with McGraw-Hill Publishing Co. of New York. He then spent two years with Cheney Bros. in Manchester, Conn., and in 1930 joined Hamilton Standard Propellers as vice-president and director.

RAYCROFT WALSH

EUGENE E. WILSON

S. F. NEWMAN has been elected president of Landis Tool Co., Waynesboro, Pa. M. A. HOLLENGREEN, former assistant general manager, has been named vice-president. Mr. Newman was originally connected with Landis Tool Co., between 1899 and 1908. In 1908 he went with Landis Machine Co., of Waynesboro, where he served many years as vice-president, returning to Landis Tool Co. as its president. Mr. Newman is widely known throughout the industry and is at the present time a member of the board of directors of the National Machine Tool Builders Association. Mr. Hollengreen was associated with Landis Machine Co. between 1926 and 1936 as assistant chief engineer. In 1936 he joined Landis Tool Co. as assistant general manager.

M. A. HOLLENGREEN

S. F. NEWMAN

BUSINESS ITEMS

FEDERAL AIRCRAFT CORP. has been organized in Los Angeles, Calif., with a capital stock of $500,000.

FOOTE BROS GEAR & MACHINE CORP., Chicago, Ill., has appointed Continental Gin Co., Industrial Div., Birmingham, Ala., as representative.

JESSOP STEEL CO., Washington, Pa., has established an export office in New York, N. Y. R. M. PAXTON, JR., in charge of domestic business, has been appointed manager of the export office.

LYNCH CORP., Anderson, Ind., has acquired MORRIS PACKING EQUIPMENT CO., Toledo, Ohio, which owns patents for the manufacture of packaging machinery.

METAL STAMPING & MFG. CO., Cleveland, Ohio, has changed its name to MORRISON PRODUCTS, INC. There has been no change in stockholders, directors or personnel.

NATIONAL AIRCRAFT EQUIPMENT CO. has been organized in Los Angeles, Calif., with a capitalization of $25,000.

NATIONAL MACHINE TOOL CO., Cincinnati, Ohio, formerly owned by HERMAN A. HOLZ, has been transferred to LEONA M. REMBOLD, GEORGE HASKELL, LOUIS GROME and PAUL LYONS, who have been identified with the operations of the company for over twenty years. Mr. Holz has completely withdrawn all interests and connections from the business.

RANSOME CONCRETE MACHINERY CO., Dunellen, N. J., has appointed EBBERT & KIRKMAN CO., Birmingham, Ala., as distributor for its line of welding tables and positioners.

ROOTS-CONNERSVILLE BLOWER CORP., Connersville, Ind., has appointed the following representatives: KENT-ERVIN ENGINEERING CO., Minneapolis, Minn.; J. T. MCKINNEY, Los Angeles, Calif.; P. J. O'MEARA CO., San Francisco, Calif.; L. S. PAWKETT & CO., San Antonio, Texas; POWER MACHINERY CO., Tulsa, Okla.; and H. K. WILSON, St. Petersburg, Fla.

VASCOLOY-RAMET CORP., North Chicago, Ill., has appointed H. BOKER & CO., New York, N. Y., as representative for its tantalum carbide cutting tools and blanks.

OBITUARIES

MORGAN J. HAMMERS, 65, president Electrol, Inc., New York, N. Y., and a pioneer in the domestic oil burner business, died in Chicago, Ill., April 28. Mr. Hammers organized the American NoKol Co. in Chicago, and manufactured the first fully automatic domestic oil burner. In 1928 this company merged with Petroleum Heat & Power Co. of which Mr. Hammers became vice-president and general manager. He had also served as president of the American Oil Burner Institute, and under the NRA in 1933 was administrator of the oil burner industry.

RALPH S. HOBSON, 43, president Hobson-Botts Co., Danbury, Conn., cutlery manufacturer, died April 19.

CHARLES H. JOHNSON

CHARLES H. JOHNSON, executive vice-president and a director of Gisholt Machine Co., Madison, Wis., died April 23, as reported in AMERICAN MACHINIST for May 1, page 3061. He was 58 years of age.

Mr. Johnson's entire career was spent in the machine tool industry, having started to work for Gisholt as a machinist in 1897. Later he went to Europe as a demonstrator and assistant in sales, with the result that he was promoted to the position of European manager, with headquarters at Cologne, Germany. On his return to Madison in 1918, he was promoted to a vice-presidency of the company. In 1932 he became executive vice-president.

ROBERT F. FITZSIMONS, 68, founder and president Fitzsimons Iron & Steel Co., Chicago, Ill., died April 29 after an illness of several months.

CHARLES WINTHROP WARNER, 76, secretary-treasurer William H. Chapman Co., Middletown, Conn., hardware manufacturer, died April 22 following a long illness.

WALTER S. RUGG, retired vice president of Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., and widely known throughout the electrical industry as an engineering and sales executive, died April 25 in New York, N. Y. following a heart attack. He was 74 years of age. Mr. Rugg began his electrical career in 1892 as a student engineer at Westinghouse, following his graduation from Cornell University. Three years later he went to the Chicago office as district engineer, later transferring to the sales force. From 1901 to 1917 he was in the New York offices, the last eight years as manager. He then returned to the East Pittsburgh works as manager of the railway department, and shortly afterwards, as manager of the marine department. In 1922 he became general sales manager of the company, and in 1925 was elected vice-president.

S. ASHTON HAND

S. ASHTON HAND, since 1918 associate editor of AMERICAN MACHINIST, died May. 4 at his home in Nassawadox, Va., following a heart attack. He was 83 years of age.

Born in Philadelphia and educated in the public schools of that city, Mr. Hand was a man of wide experience that began in his early youth. He served two years on a whaling vessel, but soon went into machine building, being associated with I. P. Morris Co., William Bement Co., and others. He also built machine tools in a shop of his own. Railroading later attracted him, and he served the Pennsylvania Railroad in different capacities.

An early member of the A.S.M.E., he was intimately acquainted with many of the founders of the society. During the World War he worked with such concerns as American Car & Foundry Co., leaving this firm in 1917 to join AMERICAN MACHINIST as associate editor. Following a severe illness in 1928, he became semi-retired and moved to Nassawadox, Va., where he continued to edit many letters to the magazine until several weeks before his death.

WILLIAM RAY ADAMS, president J. D. Adams Mfg. Co., Indianapolis, Ind., manufacturer of road maintenance and building machinery, died in Los Angeles, Calif., following an emergency operation.

EDWIN F. NORTHRUP, 74, vice-president and technical advisor Ajax Electrothermic Corp., Trenton, N. J., died April 29.

PLANT EXPANSION

BROWN AIRCRAFT CORP., Ventura, Calif., is planning a new factory for manufacture of high-speed military training planes.

BRYANT CHUCKING GRINDER CO., Springfield, Vt., has awarded contract to the AUSTIN CO. for a 14,000-sq.ft. addition to its plant. Providing a new machine shop with three 30-ft. bays, the project will represent an investment of some $40,000.

GENERAL ELECTRIC CO., Schenectady, N. Y., is erecting a $50,000 addition to its plastics department in Pittsfield, Mass.

INTERNATIONAL NICKEL CO., New York, N. Y., is planning to spend approximately $132,000 for improvements to its Huntington, W. Va. plant.

KEARNEY & TRECKER CORP., Milwaukee, Wis., is erecting a $40,000 addition to the shop addition completed in February.

MOORE SPECIAL TOOL CO., Bridgeport, Conn., has awarded contract for the construction of a new two-story brick and steel plant. Cost with equipment will be in the neighborhood of $40,000.

ROLLER-SMITH CO., Bethlehem, Pa., has transferred its Switchboard Div. to a recently acquired plant in Allentown, Pa., which will provide 21,600 sq. ft. of additional floor space.

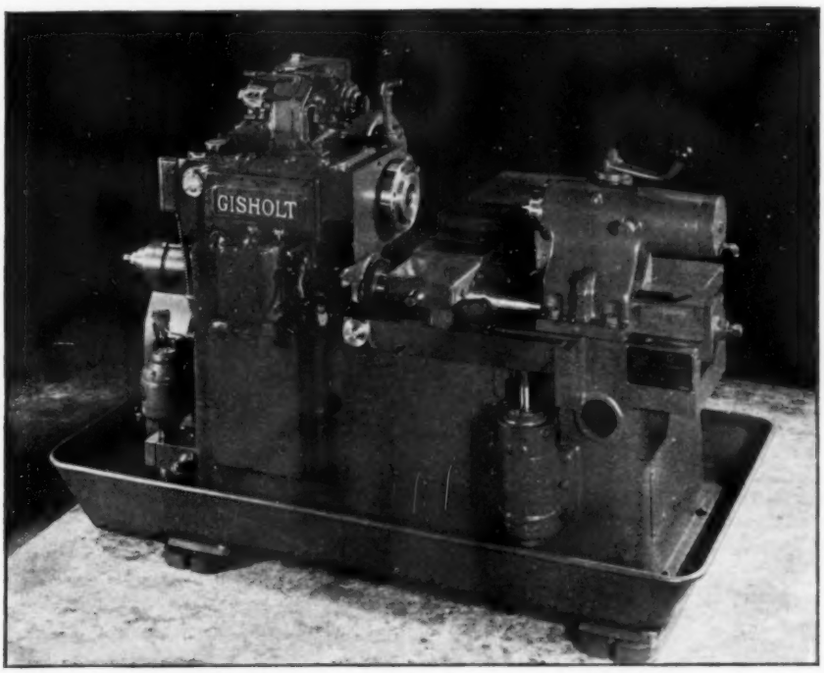
SIMMONS MACHINE TOOL CORP., Albany, N. Y., has begun construction of a 60,000-sq.ft. addition to its plant.

VICKERS, INC., is building an 80,000-sq.ft. addition to its plant in Detroit, Mich. To be of welded frame construction, the new building will cost approximately $500,000 and will be equipped with all modern conveniences. Contract for construction has been awarded to the AUSTIN CO.

VINCENT STEEL PROCESS CO., Detroit, Mich., is adding a 2,000-sq.ft. building to its heat-treating plant.

SHOP EQUIPMENT NEWS

Gisholt Offers Improved Automatic Lathe For Wide Variety of Turning Operations



The No. 12 hydraulic automatic lathe developed by Gishold Machine Co., Madison, Wis., and previously described (*AM*—Vol. 83, page 722) has been improved to increase capacity between centers from 18 to 22 in. and to increase operating efficiency. The machine now incorporates a redesigned cross feed elevating cylinder; a complete rearrangement of the air lock mechanism for the tailstock, now entirely automatically controlled from the rear slide; and some repositioning of starting switches and operating levers. This No. 12 hydraulic automatic lathe is designed so that the operator only has to place the work in the machine and pull the control lever. It is adaptable to a wide range of applications, including between centers work, arbor work, chucking work, or work that must be held in fixtures. It is suitable both for high production operations and, because it is easily changed over from one job to another, for machining parts made in small lots.

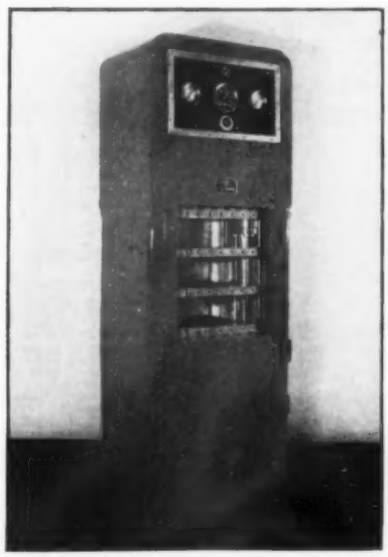
This lathe provides a swing of 16¾ in. over the bed and 12 in. over the front carriage. Features include a simplified hydraulic control system which permits handling of all functions of the machine by means of a single lever. The front carriage and the rear slide have independent hydraulic feeds. The machine is equipped with an hydraulically operated main clutch and an automatic spindle break. Automatic tool relief for the front carriage when using multiple turning tools makes it possible to fade out the tool pressure at the point of overlapping cuts. This eliminates rings and grooves in the finished surface of the work, whether it be cylinder liners, bolts, or similar pieces. Bevel gears and other work having angular surfaces are machined without the use of auxiliary slides, cams or taper attachments because the rear slide can be set at any desired angle. Unit design of the machine and the flexibility of hydraulic operation makes possible the addition of extra auxiliary slides on the bed or overhead as may be required.

Independent feeds are provided for front carriage and rear slides, one pump for each slide; feed pumps are geared to the spindle, hence rate of feed is in proportion to the speed of spindle rotation. The hydraulic system provides smooth, constant feeds in an infinite range from 0 to 0.060 in. Slides feed against and dwell at positive dead stops, insuring accuracy of finished dimensions. The 15 hp., 1800 r.p.m. motor used to drive this lathe is housed in the cabinet base. Spindle speeds range from 62 to 325 r.p.m. in the standard range. Both front and rear tools have a maximum feed of 7 in. The machine occupies floor space measuring 58 x 84 in. and weighs 5500 lb.

Farrel-Birmingham Presses Used for Molding Plastics

This 20 x 20 in. hydraulic press has been developed by Farrel-Birmingham Co., Inc., Ansonia, Conn., for the molding of small rubber and plastics articles. The housing, which includes the top, bottom and sides is a single casting. Set in the base of the housing is a cylinder made of Meehanite. The cylinder and gland are lined with bronze, and the gland studs and nuts are of stainless steel. These features prevent corrosion and are claimed to add to the ease and economy of maintenance.

The press is designed to operate



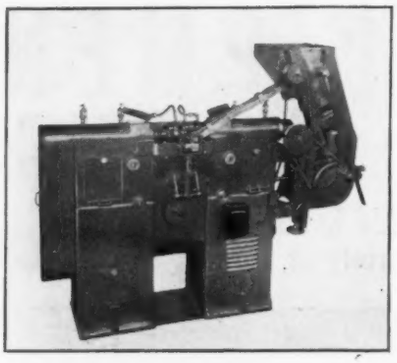
with an initial water pressure of 2,000 lb. per sq. in., giving a total pressure of 113 tons or 563 lb. per sq. in., on the platens. The press is equipped with three 20-in. square plates made of rolled steel and machined to provide a smooth finish. These plates are drilled to permit maximum steam circulation and uniform heating. Steam connections for the platens are flexible metallic tubing and are fully inclosed in the housing and covered by sheet metal guards. The latter can be removed quickly to give access to the platens

and piping. Temperature of the platens is controlled automatically by an air-operated diaphragm valve which is located in an opening at the top of the press. Temperature of platens, steam, air and water pressures all are indicated by gages mounted in a panel on the press.

Kent Duplex Horizontal Drill Feeds Work from Hopper

The Kent Machine Co., Cuyahoga Falls, Ohio, now is offering a horizontal duplex-spindle drilling machine, designed primarily for drilling cotter pin holes in screws, bolts, and similar parts, either through the head or the shank. The machine also is applicable to a variety of other drilling problems. Action of the drill spindles is such that the drills enter the opposite sides of the work simultaneously and proceed to a point near the center of the piece where one of the drills is withdrawn and the other follows through, completing the hole. The work to be drilled is held between two jaws carrying drill bushings which centralize the work. Drilling speed of spindle, feed of drill, and depth of cut can be varied independently; the former by four-step cone pulleys for single V-belt drive and the latter by change gears and adjustable link mechanisms from cams to the reciprocating control of the drill spindle sleeves.

The machine can be furnished



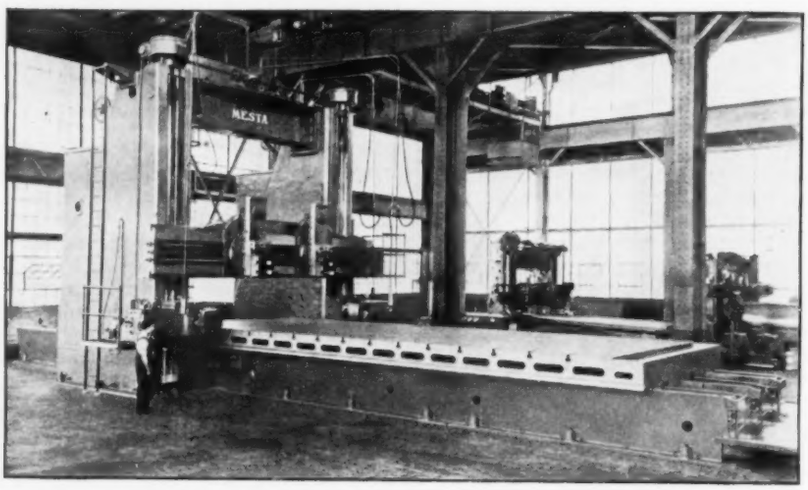
either with a semi-automatic or fully automatic work feeder. The one shown is fully automatic, including a hopper, galley from hopper to transfer mechanism and transfer mechanism which carries the work to the grip jaws. The hopper may be eliminated, and the work can be fed into a short galley from which it is taken to the grip jaws by the transfer mechanism. If desired, the automatic feed attachments may be eliminated, and the work fed by hand to the grip jaws.

The machine has capacity for drilling screws up to 9/16 in. either in diameter of shank or across flats of head. Drill capacity is ¼ in. diameter. The combination of speed and feed controls makes the machine adaptable for drilling any grade of steel. Limiting factor of production is the maximum feed and speed for the type of steel to be drilled.

Large Mesta Heavy-Duty Planer for Machining Castings Has Table Measuring 430 x 150 in.

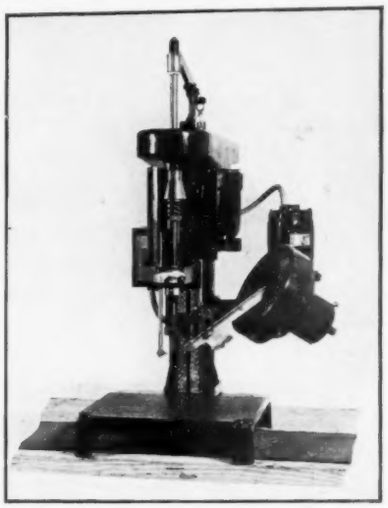
Said to be one of the largest heavy-duty planers ever built, this huge planer recently was shipped by the Mesta Machine Co., P. O. Box 1466, Pittsburgh, Pa., to a customer who will use it for accurately machining large metal castings. The machine measures 16 ft. between housings and will clear 14 ft. under the rail. The 430 x 150 in. table bears on one V-way and two flat ways. Bed length is 61 ft.

Six electric motors are required to drive this planer. All feeds are driven by electric motors under pushbutton control. A 75 hp. motor drives the table. A pendant pushbutton control station is suspended at each side of the machine, while a third station is suspended above the center of the machine and can be swung to either side as required. The machine is so large that platforms are provided at each side head so that the operator can ride with the head when adjusting it to position.



Detroit Power Screwdriver Feeds Small Screws

The Model A magazine feed power Screwdriver offered by Detroit Power



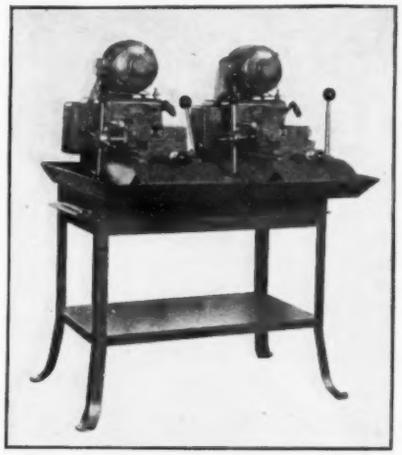
Screwdriver Co., 5365 Rohns Ave., Detroit, Mich., has a range from No. 2 to No. 6 screws from ⅛ to ⅞ in. long. The spindle clutch is said to be so sensitive that there is no danger of twisting off screw heads, even when driving a No. 2 brass screw.

The hopper is driven by an individual motor to provide a constant hopper speed, regardless of spindle speeds. The machine can be placed over a 12 in. conveyor belt, if so desired. It is arranged for operations from a foot treadle fastened to the floor, and only a touch of the toe is necessary to operate the stroke of the spindle. All adjustments are readily accessible, and the screws are always in sight of the operator. Tension to which screws are to be driven is controlled by a simple adjusting lock nut on the lower spindle.

Geometric Threading Machine Made in Three Sizes

The Geometric Tool Co., New Haven, Conn., has developed a double spindle threading machine which may be furnished in three sizes with a complete threading range from $\frac{1}{16}$ to 1½ in. diameter, providing National fine thread series pitches only in the larger diameters. This machine is said to be economical for long threads where the length of thread is sufficient to allow the operator time to unload and chuck one work holding device while a thread is being cut in the other. The machine is built up

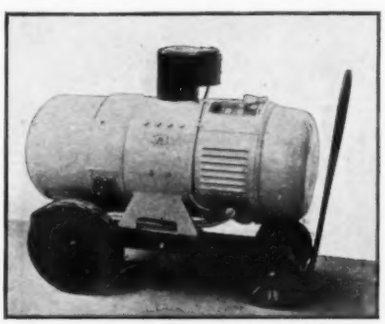
from unit assemblies, thus allowing flexibility of operation. Since the units are separate, one size of thread may be cut in one unit, with another size being cut in the other, each



being run at the proper speed for the thread being cut; each supplied with proper lubricant from an independent pump; and each having an individual chip pan. It is possible to cut a right-hand thread with one unit, and a left-hand thread with the other. If desired, only one unit need be operated.

Wilson Remote Control Designed for Arc Welders

A device just announced by Wilson Welder & Metals Co., Inc., 60 E. 42nd St., New York, N. Y. is suitable for remote control of the "Hornet" and other Wilson arc welders. To use this device the handwheel which governs the control pole of the standard welder is simply replaced by the re-



versible motor-driven Type SC remote control unit.

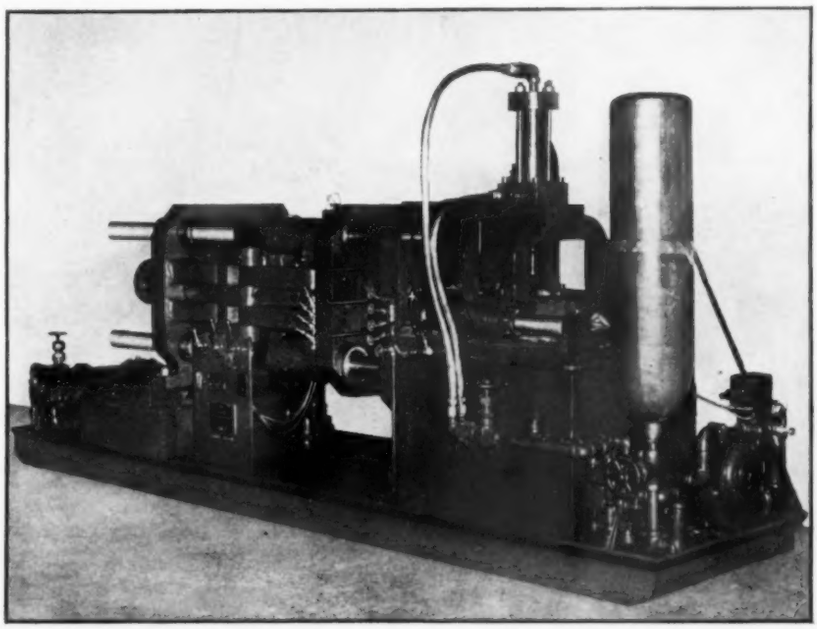
Said to cover the entire range of the machine to which it is attached, in both low and high settings, the new device allows minute adjustments in current output by merely touching one of two contacts on the electrode holder to the ground. In other words, when the electrode holder button marked "more" is brought into contact with the ground, the electric motor in the remote control housing revolves and raises the control pole core, increasing the output. The motor revolves only when actual contact is maintained. When the button marked "less", is grounded, the remote control motor revolves in the opposite direction to decrease output.

H.-V. W.-M. Barrel Plater Cleans and Plates Parts

This improved hopper-type barrel plating machine recently installed at the Chrysler-Plymouth Plant in Detroit, was built by the Hanson-Van Winkle-Munning Co., Matawan, N. J. A variety of small parts, which were difficult to clean by the ordinary dipping basket method, are run through a cleaning cycle, from hopper to hopper, and finally plated in the same series. Each hopper requires approximately 55 sec. to make a cycle.

Production through these hoppers, providing the hoppers are loaded continuously, is one hopper load into the dryer every 110 sec. The plating cylinders take from 75 to 200 lb. at a time, depending upon the size and shape of the part.

G & M Hydraulic Die Casting Machines Provide Locking Pressure of 500,000 lb.



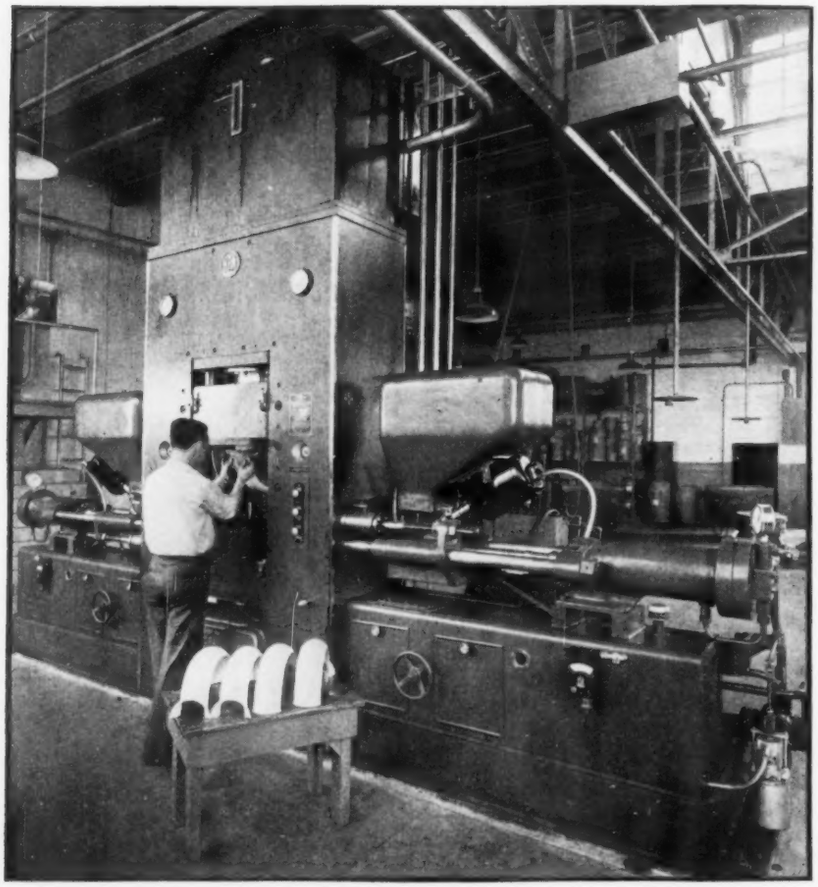
The G & M Mfg. Co., Cleveland, Ohio, has developed two improved high-pressure hydraulic die-casting machines, one for zinc, tin and lead-base alloys, and the other for aluminum, brass and magnesium alloys. Similar in construction, the machines are designed to accommodate larger dies, to increase production and to reduce flash. Base, framework, die plates and toggle links are made of steel plates, flame-cut and welded. Welding has been substituted for bolting and riveting wherever possible.

The toggle arrangement permits moving and locking of die plate with an hydraulic pressure of less than 300 lb. against the actuating mechanism. Construction and design of the toggle mechanism, however, provides a locking pressure of approximately 500,000 lb. One feature of the toggle linkage is that no strain is exerted on the link pins in stopping the forward motion of the movable die plate, as would be the case if shoes or stops were used on the links themselves. Instead, the machines are so equipped that the actuating movement of the linkage is stopped when the hydraulic piston which moves it comes in contact with the movable die plate when the die is locked.

All hydraulic regulating valves have been placed on the operator's side. High-pressure hydraulic piping is concealed in the base and the connections are oxyacetylene welded to prevent leakage. Motor and pump are mounted on the base and, in cast-

ing zinc, tin and lead-base alloys, the motor, pump, furnace and all burner equipment are likewise mounted. The base itself, 48 in. wide and 182 in. long, weighs approximately 4,000 lb. It is flanged on all sides to prevent water from the die-cooling system from running onto the floor. An hydraulic valve arrangement for ejecting and core-pulling is standard equipment on both types of machines. They are equipped with Vickers hydraulic two-stage pumps and control valves. The zinc-tin-lead-alloy machine is designed so that the gooseneck or the furnace pot can be replaced without disturbing the hydraulic piping.

H-P-M Plastic Injection Molding Press Incorporates Two Complete Injection Units



The Hydraulic Press Mfg. Co., Mount Gilead, Ohio, has announced completion of an 18 oz. vertical-type injection molding press for the Metal Specialty Co., Plastic Div., Richmond, Ind. This Model 250-V-double-9 machine incorporates two complete injection units, one on each side of the vertical, downward-acting clamp press. Each unit is hydraulically synchronized with the movements of the press, and each injection unit has a capacity of 9 oz. of material per shot. The vertical clamp press, as well as the two injection units, are individually operated, each having its own radial pump power unit.

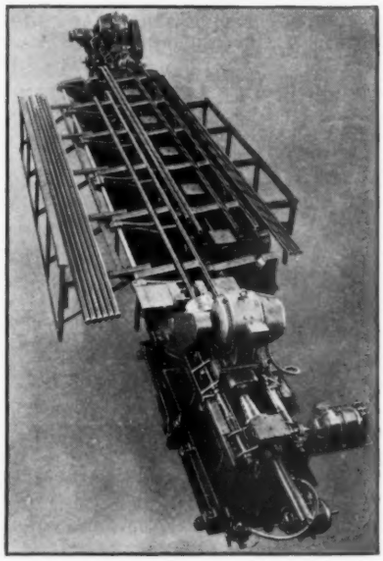
Hydraulic power, directly applied, is employed for every pressure action of the press. Torque motor driven feed mechanisms deliver the granular molding material to the injection chambers. This force feed automatically proportions the material to the plastic output. A circulating fluid, heated electrically by immersion units, transfers heat to the material in the injection cylinders. Positive connections between the injection chamber nozzle outlets and the mold inlets is provided by direct hydraulic means. No mechanical adjustments are required. The nozzles automatically withdraw slightly at the end of each cycle, breaking the sprues. A wide separation can be obtained quickly for access to the nozzles. Molds are clamped by direct straight-line hydraulic action. This clamping arrangement is the same as that used in a standard downward-acting "Fastraverse" platen press.

The H-P-M variable-volume radial pump which generates pressure for the clamp unit provides a constant pressure against the clamp ram with a minimum of power consumption. An automatic control regulates this pressure according to demand, maintaining the output near zero when the ram is stationary, while holding full pressure on the molds. Automatic follow-up of full load is accomplished by this same control.

Specifications of the No. 250-V-double-9 are as follows: vertical clamp pressure, 250 tons; maximum mold size, 24 x 24 in.; minimum shut height of mold, 14 in.; maximum opening between platens, 29 in.; maximum stroke of mold carrier platen, 15 in.; maximum weight of material injected per cycle, 18 oz.; pressure per sq. in. on material in injection chamber, 20,000 lb.; number of complete cycles per minute, 3 to 5.

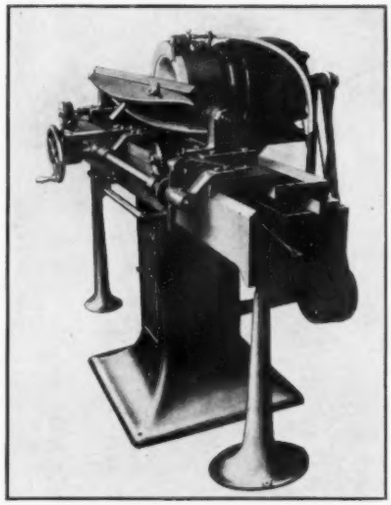
Stamets Pipe Threader Operates Automatically

Consisting of two opposed threading machines and electrically operated mill tables which deliver pipe to the machines, convey and position it alternately for two threading operations, and discharge it to the unloading skids, this automatic pipe threading machine developed by William K. Stamets, 4026 Jenkins Arcade Bldg., Pittsburgh, Pa., is electrically synchronized and interlocked. The threading machines have non-rotating chucks which hold and align the pipe with the die head while the threads are being cut. The rotating die is carried on the spindle supported by the carriage, which has power rapid traverse in both directions. V-belt and worm gears provide a smooth drive to the spindle from the adjustable speed drive motor mounted on each threading machine.



Threading feed is by means of an

accurately ground leadscrew geared to the spindle and having provision for change to any desired pitch of thread. In operation, a load of pipe is placed on skids, and allowed to roll down against stops. When the unit is started, the first pipe is picked up and discharged onto rolls which moved the pipe against a stop in proper location endwise for threading. The pipe then is lifted from the rolls and carried into the machine chuck which closes automatically and the threading operation is performed. As the threading operation is completed, the chuck opens and the tables again go into operation, taking the pipe to the second threading machine and delivering another pipe to the first machine. The cycle is repeated.

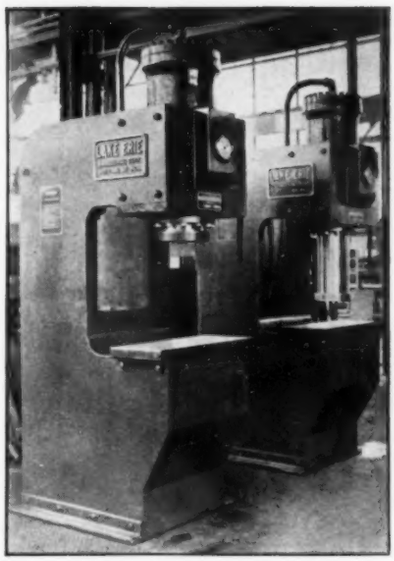


Rogers Improved Grinder Made in Five Sizes

An improved Type B automatic knife grinder has been announced by Samuel C. Rogers & Co., 191 Dutton Ave., Buffalo, N. Y. This grinder is made in five sizes to accommodate knives from 26 to 34 in. long. Among the features of this unit are a heavy, well-reinforced carriage bed, a sturdy knife bar and increased over-all weight which combine to provide greater accuracy. The machine is adapted for grinding knives edge up or down. It is equipped with a 1½ hp. motor and a 10 in. diameter grinding wheel. Both paper and woodworking knives, as well as light shear blades, can be ground.

Lake Erie Hydraulic Press Designed for Straightening

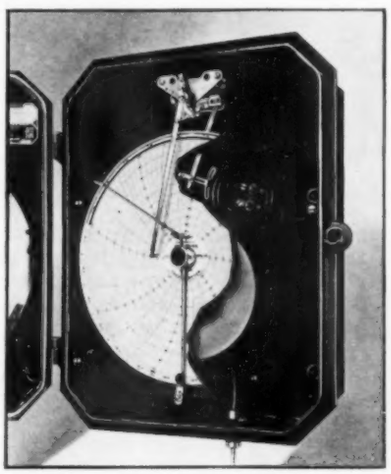
The addition of a line of hydraulic straightening presses using a gap frame design has been announced by the Lake Erie Engineering Corp., 288 Perry St., Buffalo, N. Y. The two presses shown are rated at 66 tons capacity, and have pressures accurately controlled by a hand lever at



the side of the cylinder. Stroke of these presses is 16 in. Operating speeds are 55 in. per min. when closing, 31 in. per min. when pressing, and 70 in. per min. return. The entire press is self-contained with the pumping unit inclosed in the base. Working space is accessible for convenient handling of work pieces. These presses are adapted for all types of straightening work, including finished shapes such as aircraft parts and similar pieces requiring straightening after drawing or forming.

Taylor "Fulscope" Recorders Offered in Several Styles

The Taylor Instrument Cos., Rochester, N. Y., have announced a line of "Fulscope" recorders for temperature, humidity, pressure, load, weight of flow, liquid level, and receivers for pneumatic transmission systems. Exclusive of the controller mechanism, the recorders and recording controllers are identical. Even the cases are drilled and tapped to receive any of the size standard control mechanisms should it be desirable to add it

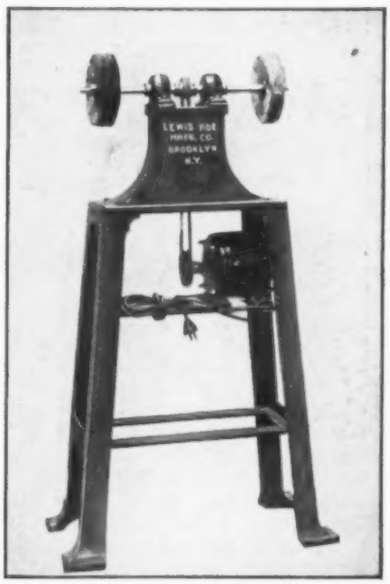


at a later date. Dust and moisture are sealed from the case by Neoprene door gaskets and a positive latch.

A specially designed mechanism which combines the chart locking device and pen lifter reduces time required for changing charts to a minimum. A die-cast aluminum chart plate gives a smooth surface for pencil notations on the chart and for carrying the chart clamp and pen lifter. These instruments are available with 10 or 12 in. charts and with one, two or three pens. Among other features these instruments include a new electric chart clock with improved coil design, totally inclosed oil-immersed gears, and slower motor speeds. A spring driven clock is optional. These instruments also are available in explosion-proof types.

Lewis Roe Polishing Stand Driven by 1/4 hp. Motor

A small polishing machine for light buffing and coloring has been developed by the Lewis Roe Mfg. Co., 1050 DeKalb Ave., Brooklyn, N. Y., to take the place of heavier machines for the same work. This unit consists of a head and stand, and is driven by a ¼ hp. a.c. or d.c. motor which is



mounted under the head. The unit has a ⅝ in. spindle mounted in two self-aligning ball bearings. V-belt drive is arranged so that uniform belt tension is maintained. The entire unit weighs approximately 100 lb.

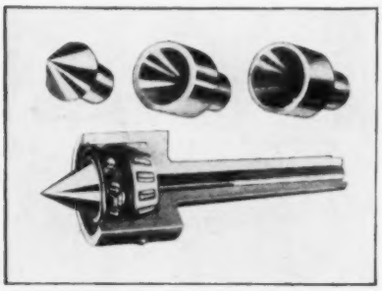
Holophane Reflectors Designed for Crane Mounting

"Cranelite" reflectors, offered by Holophane Co., Inc., 342 Madison Ave., New York, N. Y., are made to withstand the severe service of under crane mounting. They are fastened to the crane by 10-in. diameter, ½-in.

thick steel plates. Weight of the unit is suspended from the plate by three compound double-acting steel springs. These springs absorb shock up and down and in any laterial direction, thereby effectively eliminating shock and whip. Good practice is to space units on 20-ft. centers.

Ideal Live Centers Have Changeable Inserts

Three interchangeable inserts or centerpieces are provided with the live center offered by Ideal Commutator Dresser Co., 1057 Park Ave., Sycamore, Ill., for holding centered and uncentered work. These inserts include: (1) a male insert for work already



centered, (2) a plain female insert for uncentered work, and (3) a female insert with three raised lands for uncentered work having a flat or burred keyway. Inserts are quickly removed by a knockout screw. All parts of the live center are hardened and ground and precision bearings are used.

Rogers Regulator Valve Incorporates Pressure Gage

The Dayton Rogers Mfg. Co., 2830 S. 13th Ave., Minneapolis, Minn., has placed on the market a combination pressure gage and self-contained reducing regulator valve for receiving a varying or high pressure at the inlet side and automatically delivering a constant reduced pressure at the outlet side. It is suitable for all types of air pressure control. This unit is designed for use in limited spaces.

A safety release valve is provided in the body of the regulator, together with a built-in filter on the inlet side. The filter is of the replaceable cartridge type and can be removed without the use of special tools or without dismantling or dismounting the

regulator. This filter prevents dust, dirt and other foreign substances from entering into the equipment being controlled and regulated. Three extra regulator seats are in a compartment on the adjusting screw.

Barrett-Cravens Lift Truck Handles Light Weight Items

Known as the "Half Ton" lift truck, an addition to the line of lift trucks made by Barrett-Cravens Co., 3255 W. 30th St., Chicago, Ill., is a general-purpose unit designed for handling light weight items in industrial plants and warehouses requiring lift equipment. This unit has a full 2 in. lift for loads handled on skids, and can

be used as a floor truck for bulkier single objects. Front wheels are of the swivel type. A tubular steel handle lifts the loaded skid when pulled down to an angle slightly more than 45 deg. Truck platform is lowered by a pull on the trigger chain and can be accomplished with a single finger. Truck is of all-welded steel construction with ball bearings on all four wheels.

Bodine Type K Motors Have 1-1500 hp. Normal Output

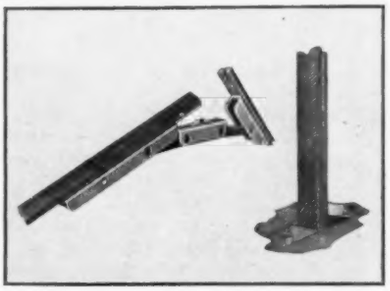
Only 2⅜ in. wide and high, with 1⅝ in. over-all length, excluding the ⅝ in. long shaft, the Type K capacitor motor offered by Bodine Electric Co., 2264 W. Ohio St., Chicago, Ill., can be supplied with three different windings; synchronous capacitor, non-synchronous capacitor, and dynamic braking capacitor. Standard ratings on 60 cycles are, respectively: 1/1500 hp. at 1,800 r.p.m.; 1/1000 hp. at 1,700 r.p.m.; and 1/1500 hp. at 1,200 r.p.m. Motor input is 8 watts or less.

Normally, three leads are brought from the motor and it can be re-

versed, even when running, by means of a single pole, double throw switch. The capacitor, furnished with the motor, has a bracket for separate mounting. Operation is at 110 volts, a.c. Motors wound for lower voltages can be built to order. These motors are specially adapted for devices designed for continuous operation, such as industrial controllers, instruments, timers and similar units.

Grob Improved File Chains Provide Perfect Alignment

Improved files and file-chains for continuous motion filing machines have been announced by Grob Bros., Grafton, Wis. Construction of these files provides alignment through an overlapping feature. As the files pass and follow each other, there is a smooth, clean-cutting action which eliminates chipping. Into the ends of the files on the rear side, small slots are milled which closely fit into projections of the chain lengths behind the files. Thus, as the files enter

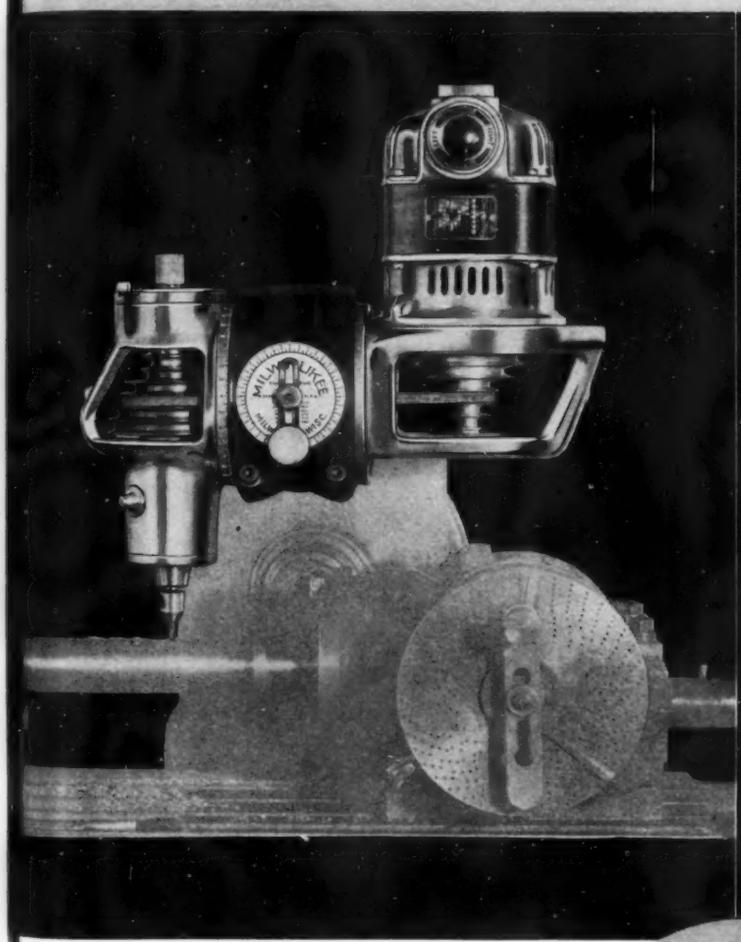


ANNOUNCEMENT...

The Midgetmill and Speedmill, high-speed milling attachments formerly produced and sold under the name of DALRAE by the DALRAE TOOLS CO., Syracuse, New York, are now part of the K&T Milwaukee line of modern milling machine attachments and accessories.

The efficient design and high quality of construction of both the Midgetmill and the Speedmill will be maintained — in keeping with the accepted and recognized K&T Milwaukee Milling Machine standards of performance and quality.

KEARNEY & TRECKER CORPORATION
MILWAUKEE, WISCONSIN, U.S.A.



The SPEEDMILL

— For accurate end mill speeds up to 3200 r.p.m. Easy to operate, furnishes closer sizes and improved finishes. A profit-producing tool, adapted to all types of milling machines.

The MIDGETMILL

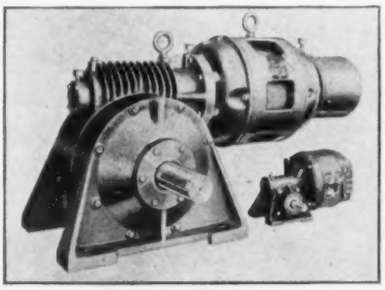
— Designed to get the most from small tools by providing the necessary high speeds. Equipped with the "Thou-Meter" giving a continuous reading in thousands at which the tool is operating. Completely universal—adaptable to any milling machine—fast, safe and easy to set up.

MILWAUKEE MILLING MACHINES

in a straight line path after leaving the pulley they are, individually and independently from one another, locked into alignment since the slots of the files lock with the projections of the chain link. The file chain in the working zone is closely guided by the file support guide. Chain guide is slightly deeper than the depth of the chain to provide chip clearance.

Janette Worm Gear Reducers Offered in Six Sizes

Type RW worm gear style reducers offered by Janette Mfg. Co., 556-558 W. Monroe St., Chicago, Ill., are built in six sizes with up to 10 hp. capacity. The smallest and largest of this group of reducers is illustrated. Single-phase, squirrel-cage, slip ring and direct current motors can be used for driving these motor-

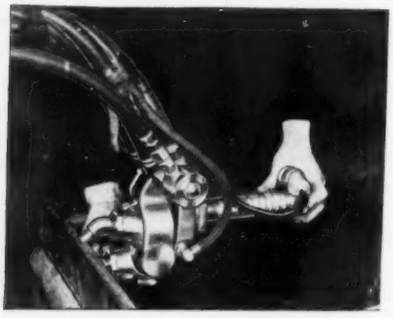


ized units. Single reduction worm gears are used. Fitted with motors ranging from ⅛ to 10 hp., these reducers have output speeds of from 12.7 to 447 r.p.m.

Type RWP reducers feature a combination of worm and planetary gearing. It is claimed that high efficiencies and quiet operation are obtained by using worm gearing for the first reduction and planetary gearing for the second reduction. The planetary units are supplied in four sizes, with motors of 1.6 to 10 hp., and with countershaft speeds from 5.9 to 52 r.p.m.

Progressive Welding Clamp Increases Handling Speed

Announced by The Progressive Welder, 3001 E. Outer Drive, Detroit, Mich., this hydraulic welding-cable clamp is said to increase welding gun handling speed, reduce operator fatigue and provide full current transfer for more uniform welds. The



clamp is designed so that the cable and gun are locked hydraulically while pressure is "on" for a weld. The moment pressure is released, the clamp unlocks, permitting the gun to be swiveled to a different position with little or no movement of the cable. This "unlocking-locking" feature assists the operator in holding the gun steady during a weld. The device operates directly from the hydraulic pressure system. Clamp is made in five different sizes to accommodate various types of sliding contact or pincer type welding guns. It is recommended for use with the company's recently announced all-in-one "No-Kik" welding cable.

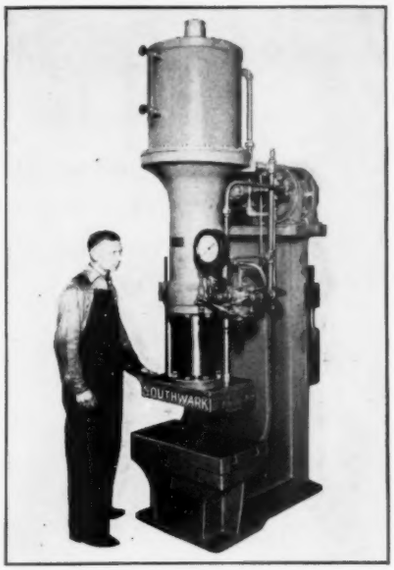
Cutler-Hammer Starter Protects Polyphase Motors

Cutler-Hammer, Inc., 205 N. 12th St., Milwaukee, Wis., has announced a number of improvements in their Bulletin 9586 across-the-line starter for the control and protection and polyphase squirrel-cage motors up to

5 hp. The improvements include: a streamlined, hook-on cover held by one fastening screw; easy removal of operating mechanism for wiring and conduit work; improved vertical contacts with insulators which protect contact springs against even minor heat transmission; and a small-size overload relay with improved operating characteristics. An overload trip indication is a further improvement.

Baldwin Hydraulic Presses Are Self-Contained

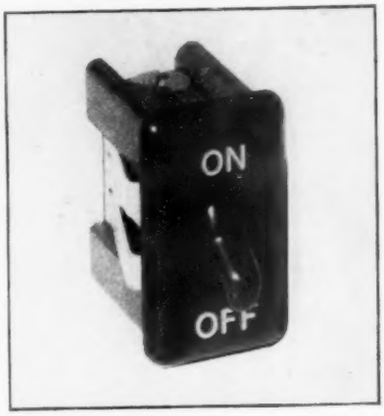
Hydraulic presses for general utility work are being made by Baldwin Southwark Div., The Baldwin Locomotive Works, Philadelphia, Pa. These self-contained units incorporate control features ordinarily found only in larger presses. The standard presses are built in 65 and 80 ton capacities and are suitable for a wide range of work. A single control, either hand or foot operated, permits the operator to inch, stop or reverse the platen at any point in its stroke. This feature is useful in assembling or straightening work. Another set-



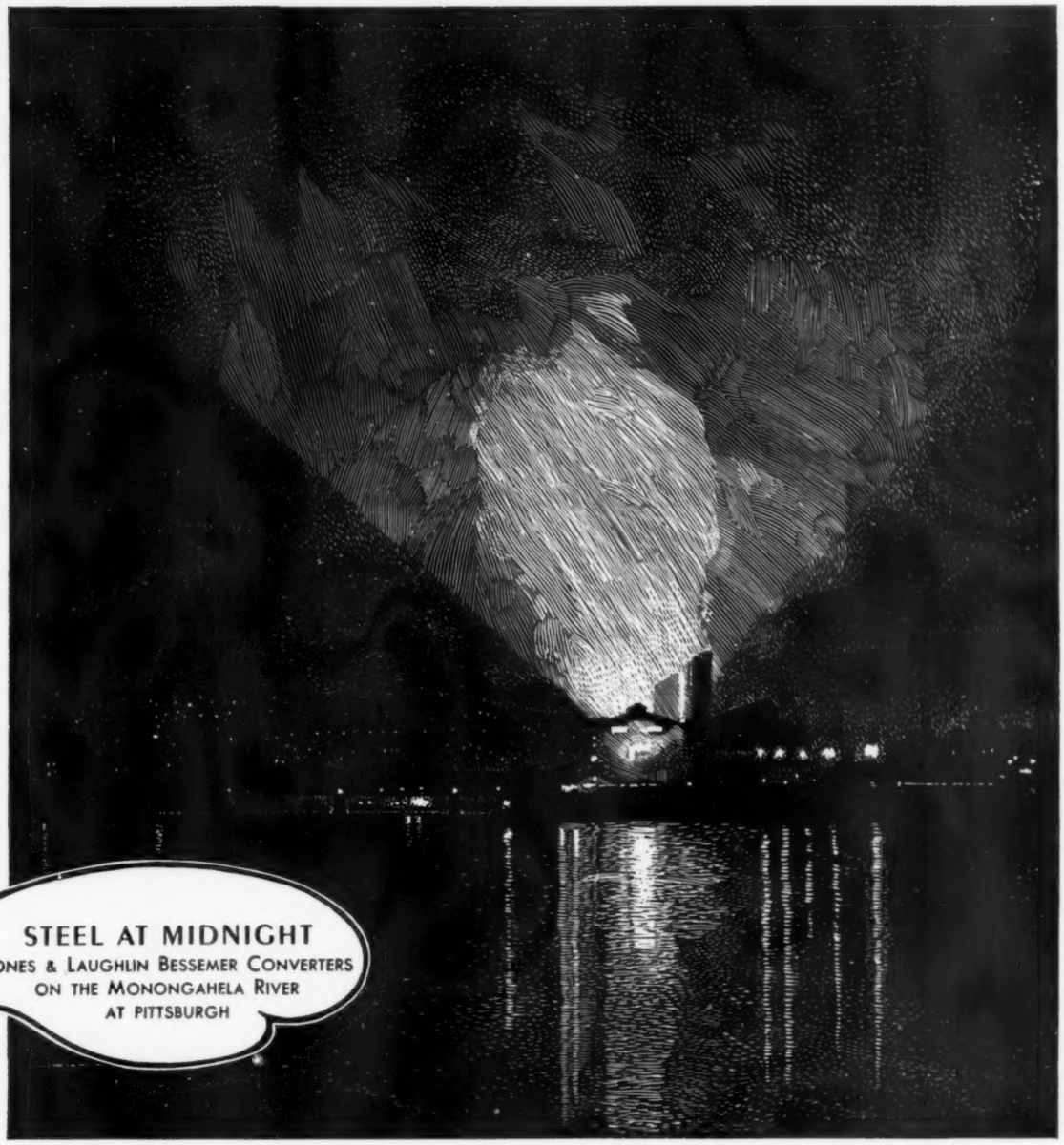
ting of the control makes the press semi-automatic in operation. That is, rapid approach until the work is met, build-up to a predetermined pressure, and automatic reversal. This feature is particularly useful in die work. If it is preferred, the platen can be reversed automatically when it reaches a given position.

Hart Single-Pole Switch Features "Snap In" Mounting

A single-pole toggle switch for 10 amp. at 115 volts or 5 amp. at 230 volts a.c. has been developed by the Hart Mfg. Co., Hartford, Conn. This



switch has a "Snap-in" mounting. The only provision necessary to mount this switch is a rectangular $1\frac{7}{32} \times \frac{3}{4}$ in. opening in the panel or base. Screws are not required for fastening it into position as the switch is furnished with a spring lock which permits the switch to be clipped into position. Removal is accomplished by compressing the spring from the back. It is recommended for controlling fractional horsepower motors, fans, signal systems, lamps, relays and other appliances. It also may be applied to low voltage d.c. circuits. As a companion piece, the company has announced



YOUR AUTOMATIC MACHINES ARE WORTH MORE TODAY

How? Well, with the new, uniform free-cutting qualities of J & L Bessemer Flame Control* Cold Finished Screw Steel, hundreds of automatic screw machines in shops throughout the country are producing better steel parts, and at a faster rate. Therefore, improved and increased production with no added equipment. Manufacturers now using this revolutionary steel are enjoying very substantial production increases. Proof? See your J & L salesman this week. He has the facts it will pay you to know...or let us mail these facts to you.

**Bessemer Flame Control is one of several methods on which patent applications have been filed by Jones & Laughlin Steel Corporation*

J&L
Hot & Cold Rolled
Sheet & Strip
Forging Steel
Jalcase Steel
Cold Heading
& Spring wire

JONES & LAUGHLIN STEEL CORPORATION

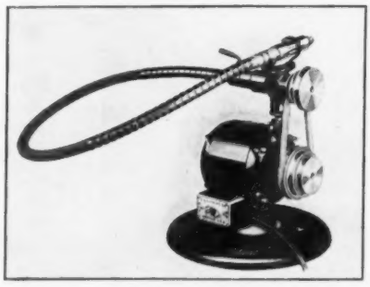
AMERICAN IRON AND STEEL WORKS
JONES & LAUGHLIN BUILDING, PITTSBURGH, PENNSYLVANIA
Sales offices, warehouses and distributors located in major cities — consult classified telephone directories.

J&L STEEL

a compact convenience outlet which is mounted in the same convenient manner. It, too, is molded of plastic and is equipped with large bronze contact surfaces.

Redesigned Haskins Units Now Have Round Base

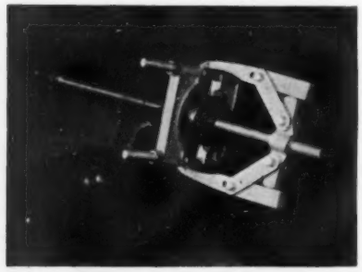
The R. G. Haskins Co., 2760 W. Flournoy St., Chicago, Ill., now offers its bench-type flexible shaft machines with a redesigned round base so proportioned for each unit that it provides for a maximum of stability



with a minimum of bench space required. The motor is fastened to the base by means of a ball-bearing swivel plate having a full 360-deg. swing. These bench-type units are furnished in ¼ and ½-hp. sizes, and are arranged for either single-speed direct drive or multispeed countershaft drive.

Owatonna Attachments Have Knife-Like Edges

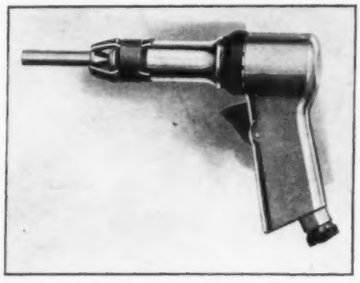
The accompanying illustration shows the application of OTC pulling attachments with Gripomatic pullers made by Owatonna Tool Co., 353 Cedar St., Owatonna, Minn. Four sizes of these attachments are available, ranging in capacity from 2¼ in. minimum to 19¼ in. maximum, for use with various sizes of Gripomatic



pullers. These attachments are used when removing gears, bearings, bushings, pinions and other parts which are flush against housings or obstructions, and where it is impossible to obtain a grip with a jaw puller. In the case of a bearing, the knife-like edges of the tool are forced behind the bearing so that the strain is applied against the inner race. In this manner bearings can be removed without damage.

I-R Light-Weight Hammer Available in Two Models

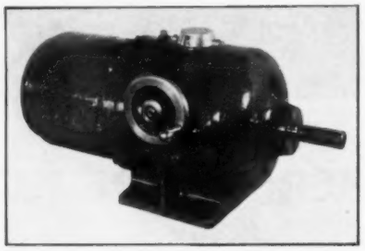
Type AV riveting hammers offered by Ingersoll-Rand Co., 11 Broadway, New York, N. Y., are light-weight, air-operated units, suitable for use in the fabrication of iron, steel and aluminum products. It is available in two types; one a short-stroke, fast-



hitting model for ordinary use; the other, a long-stroke, slow-hitting machine, is designed primarily for aluminum, dural or soft iron rivets. Both types can be furnished with either a pistol grip, an offset, or a pushbutton handle. These tools can be adapted for extra light chipping, scaling and calking work when equipped with the proper chisel.

Lenney Variable Transmission Extensively Redesigned

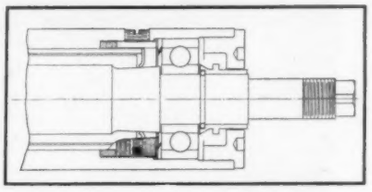
The variable speed transmission made by Lenney Machine & Mfg. Co., 733 Niles Rd., Warren, Ohio, now has a speed range of 225 to 925 r.p.m. when driven by a 1,750 r.p.m. motor. The automatic pressure regulating clutch



now is actuated by the amount of load at the output shaft, thus preventing slipping. Design has been changed so as to eliminate practically all thrust in cross shaft and bearings. Speed indicator dial conveniently located on the top of the unit allows the operator to select speeds accurately. Oil is sealed within the case and lubrication is by the splash method.

Dumore Grinding Quills Feature Preload Adjustment

To insure long bearing life and precision performance at a wide variety of speeds, the Dumore Co., Racine, Wis., has perfected a preload adjustment for ball bearings used in grinding quills. The amount of preload is determined by the short, stiff spring adjusted by means of an internal nut in the quill tube. With the preload



spring located on the inside edge of the outer bearing raceway, the pressure due to expansion is counteracted by the spring so that the pressure on the bearings decreases at high speed and increases at lower speeds. The spring arrangement permits the bearings to run freely, operating at high speed with minimum wear.

NEW MATERIALS

Dykem Hi-Spot Blue Used for Scraping Surfaces

"Hi-Spot" Blue No. 107 is a soft, uniform paste, intensely blue, that spreads easily and evenly, and transfers clearly from master surface gage to show up the high spots on the bearing surface. Made available by the Dykem Co., 2301 N. 11th St., St. Louis, Mo., this non-dying blue saves the scraper's time since it remains in condition on the work indefinitely. No night clean-up and morning rebluing is necessary.

M. & W. Enamels Made For Baking with Infra-Red Lamps

Two lines of enamels, especially designed to work at high-speed baking schedules in infra-red lamp (radiant heat) ovens, have been announced by Maas & Waldstein Co., 438 Riverside Ave., Newark, N. J. Use of these enamels allows the finisher to take full advantage of the short warming-up periods and rapid baking of the infra-red lamp ovens. These two new lines are "Raydur" synthetic baking enamels and Raydur "Duart" wrinkle enamels. With infra-red heat, both will bake to a hard, durable surface in 15 to 20 min. and can be handled for assembly half an hour later with little danger of marring. Color retention is good, and the adhesion on various metals and on molded bakelite is excellent. "Raydur" baking enamel can be supplied in high gloss and semi-gloss finishes, while Duart wrinkle enamel can be supplied in grades to form fine, medium and coarse patterns. Both are furnished in black, white and most colors.

AMER

By

Production Equipment	New England		Middle Atlantic		South
	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Unit Now in Place
Bending Machines					
Apron and Press Brakes	1,292	842	3,011	1,786	859
Bending, Straightening and Forming Rolls	1,096	846	3,239	2,240	1,033
Pipe and Bar	320	244	1,396	943	402
Other	424	293	1,516	871	103
Boring Machines					
Horizontal Boring, Drilling and Milling	1,260	952	2,881	2,380	462
Vertical Boring Mills	1,297	1,125	4,205	3,683	1,079
Precision, Horizontal and Vertical	343	203	346	214	200
Jig	220	62	1,382	610	50
Other	103	82	164	126	41
Broaching Machines					
Horizontal	408	302	755	505	27
Vertical	294	280	303	119	11
Cutting-off Machines					
Bandsaw	1,476	786	3,585	1,758	382
Rotary hot or cold saw	950	829	1,574	1,278	433
Hacksaw	2,646	1,790	5,843	4,027	1,105
Abrasive disk	582	224	903	315	48
Other	229	161	1,682	1,199	93
Drilling Machines					
Upright:					
Single-spindle	17,731	13,602	19,931	14,357	2,990
Multiple-spindle	10,081	8,224	5,734	4,016	458
Sensitive:					
Single-spindle	1,830	3,442	8,474	5,093	1,586
Multiple-spindle	3,333	2,682	3,994	3,300	129
Radial	2,775	1,958	6,267	5,003	1,561
Special Purpose, Single and Multiple Spindle	1,181	894	1,225	932	26
Centering machines	570	506	571	495	37
Other	578	482	1,291	720	64
Forging Machines					
Bulldozers	127	107	591	572	19
Hammers:					
Board and Rope Drop	1,298	1,253	2,515	2,213	27
Steam or air operated	519	472	1,691	1,161	92
Other power hammers	784	751	1,117	1,031	22
Forging presses	407	397	184	179	6
Forging machines (upsetting)	164	164	773	769	44
Swaging machines	245	162	880	587	2
Other	1,548	809	492	384	6
Gear-Cutting Machines					
Formed rotary-cutter type:					
Spur and helical	975	829	863	695	9
Bevel	260	172	202	164	3
Generators:					
Shaper type	302	172	348	265	10
Bevel, spiral bevel and hypoid	96	51	178	141	4
Herringbone	14	14	.....	.....	1
Hobbing	377	234	791	528	10
Shaving and finishing	5	.....	63	.....	.....
Other	130	55	406	282	.....
Grinding Machines					
Cutter and tool	5,574	3,876	8,007	5,619	91
Drill	1,216	629	2,679	1,342	23
Floor (pedestal type)	7,632	5,808	12,596	9,767	4,23
External cylindrical, plain and universal	3,433	2,367	3,881	2,731	62
Internal cylindrical	869	568	1,639	1,227	35
Surface, horizontal and vertical	4,141	2,629	7,952	4,505	47
Disk, horizontal and vertical	1,494	1,216	2,512	1,777	16
Thread	407	226	66	46	1
Gear tooth	137	24	69	.....	1
Centerless	321	161	935	484	2
Other	2,371	1,628	7,756	4,258	65
Honing and Lapping Machines	491	280	366	106	1
Keyseaters	399	361	1,266	1,060	31
Lathes					
Bench	6,136	4,587	8,324	5,534	49
Engine (incl. toolroom)	21,907	19,052	28,013	23,146	5,82
Automatic multiple-spindle(inc. screw machines)	2,476	1,819	3,190	2,450	2
Automatic single-spindle (incl. screw machines)	9,543	8,002	5,813	4,187	9
Semiautomatic	1,952	1,604	1,863	1,534	1

AMERICAN MACHINIST 1940 Inventory of Metal-Working

By Geographic Sections

lantic	South Atlantic		East No. Central		East So. Central		West No. Central		West So. Central		Mountain		Pacific	
lore Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old	Total Units Now in Place	More Than 10 Years Old
1,786	859	557	6,014	3,699	168	118	1,220	679	284	239	52	25	740	343
2,240	1,033	665	4,683	3,197	146	146	1,207	878	273	223	89	89	676	415
943	402	265	1,347	614	61	.....	499	371	184	158	52	38	331	135
871	103	87	1,550	954	.....	.....	786	257	31	31	.....	.....	417	64
2,380	462	352	4,382	2,981	40	40	435	316	149	102	88	68	185	158
3,683	1,079	881	3,936	3,362	52	27	704	638	225	187	134	88	174	140
214	200	155	1,291	523	.....	.....	237	95	16	16	.....	.....	5	.....
610	50	10	788	421	.....	.....	36	10	5	.....	.....	.....	60	2
126	41	41	123	49	18	18	60	55	20	20	27	14	.....	.....
505	27	15	1,295	914	34	34	242	220	8	8	5	5	46	41
119	11	6	1,160	339	18	.....	89	75	11	5	.....	.....	5	.....
1,758	382	269	4,639	2,740	111	35	827	525	132	65	8	8	338	155
1,278	435	346	1,591	1,144	34	34	362	301	79	52	32	32	141	136
4,027	1,105	786	7,347	5,302	274	218	1,300	1,046	372	270	79	27	616	278
315	48	46	1,317	637	61	61	231	36	43	18	.....	.....	174	36
1,199	95	65	948	543	.....	.....	30	23	.....	.....	.....	.....	61	.....
14,357	2,990	2,367	35,051	26,035	620	408	4,201	3,390	929	720	200	150	2,573	1,610
4,016	458	324	9,282	6,788	105	71	1,461	1,215	16	11	19	.....	369	164
5,093	1,586	1,019	14,258	8,499	317	129	1,613	793	119	27	16	5	601	341
3,300	129	71	5,063	3,826	.....	.....	1,511	745	5	.....	.....	.....	58	33
5,003	1,567	1,277	8,393	5,997	79	79	817	741	256	201	96	71	484	335
932	20	45	5,900	1,919	58	58	551	372	20	20	.....	.....	14	14
495	370	272	1,081	859	32	14	190	170	31	31	19	19	24	24
720	60	55	926	626	.....	.....	103	68	.....	.....	5	5	97	19
572	194	173	1,520	1,277	36	18	236	234	160	160	19	19	29	24
2,213	272	258	1,679	1,536	162	122	188	168	36	36	.....	.....	176	167
1,161	921	850	1,272	982	20	20	714	695	155	144	84	84	192	134
1,031	221	221	1,212	1,111	106	106	329	292	151	104	32	32	98	84
179	62	62	587	383	.....	.....	70	70	5	5	.....	.....	.....	.....
769	449	420	883	639	20	20	331	317	74	74	52	38	27	27
587	29	27	667	505	46	46	77	44	5	5	19	19	19	14
384	66	52	356	159	22	22	46	41	34	.....	5	5	34	34
695	91	73	2,641	1,855	18	18	149	110	16	5	11	11	84	76
164	38	6	866	259	.....	.....	.....	.....	25	5	.....	.....	.....	.....
265	100	65	838	629	18	18	94	94	.....	.....	11	11	40	35
141	49	26	1,682	640	5	5	.....	.....	.....	.....	5	5	6	.....
.....	11	.....	205	165	.....	.....	20	.....	22	5	.....	.....	.....	.....
528	107	58	4,877	1,627	25	25	56	51	11	5	11	11	103	69
.....	.....	.....	1,807	442	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
282	.....	.....	1,395	402	.....	.....	.....	.....	22	.....	.....	.....	84	59
5,619	918	762	11,081	7,665	165	85	1,227	892	282	90	100	21	471	339
1,342	231	164	2,690	1,839	71	71	356	223	170	76	25	5	156	97
9,767	4,237	2,922	20,227	15,662	137	119	3,387	2,756	666	454	350	244	1,156	565
2,731	628	384	9,018	6,207	14	14	557	440	51	23	11	11	127	112
1,227	351	272	2,653	1,766	23	5	239	197	16	11	19	5	92	76
4,505	473	284	7,751	5,215	18	.....	595	469	25	3	5	5	349	198
1,777	163	144	3,145	2,130	29	29	389	356	40	29	16	16	272	188
46	18	.....	195	58	18	.....	.....	.....	11	5	.....	.....	.....	.....
.....	14	14	226	47	.....	.....	.....	.....	.....	.....	5	5	.....	.....
484	24	.....	1,675	1,099	.....	.....	106	59	5	.....	.....	.....	11	6
4,258	659	452	4,814	2,841	158	122	656	507	163	61	27	.....	668	332
106	14	.....	1,218	525	.....	.....	188	79	49	.....	14	14	7	2
1,060	315	265	1,448	1,194	50	32	305	279	98	65	11	11	107	40
5,534	499	332	5,743	4,189	17	17	557	380	77	25	.....	.....	245	115
23,146	5,820	4,994	31,021	25,157	434	397	4,470	3,895	991	827	338	314	1,628	1,215
2,450	298	200	12,444	9,621	.....	.....	488	311	5	5	.....	.....	11	11
4,187	962	372	11,476	7,931	14	14	1,195	710	8	8	.....	.....	358	184
1,534	102	68	2,471	1,727	43	43	638	492	18	18	.....	.....	.....	.....
65	611	475	38	24	.....	.....	456	415	.....	.....	82	68	32	19

king Equipment

Plant-Service and Miscellaneous Equipment

	Total Units Now in Place	More Than 10 Years Old	Per Cent over 10 Years Old
Heat-Treating and Hardening Furnaces			
Gas	21,017	13,332	63
Oil	9,489	7,337	77
Electric	8,645	3,657	42
Plating Equipment			
Tanks	16,232	7,937	48
Machines	4,152	1,830	44
Tumbling Barrels	17,454	11,806	67
Finishing Equipment			
Baking and Drying Ovens:			
Gas	8,780	5,136	58
Oil	1,084	847	78
Electric	2,812	1,457	51
Parts Washing Machines	5,451	1,694	31
Oil Extracting Machines (from Chips)	2,552	1,838	77
Air Compressors	21,730	14,601	67
Hoists			
Chain, hand	96,899	57,996	60
Electric	23,545	14,128	60
Pneumatic	28,045	20,160	72
Cranes			
Jib	13,910	9,870	71
Overhead traveling	26,309	19,709	75
Monrail or tramrail	16,239	7,631	47
Total for Metal-Working Industry	324,345	200,966	62

Other	2,371	1,628	7,756	4,258	659
Honing and Lapping Machines	491	280	366	106	14
Keyseaters	399	361	1,266	1,060	315
Lathes					
Bench	6,136	4,587	8,324	5,534	499
Engine (incl. toolroom)	21,907	19,052	28,013	23,146	5,820
Automatic multiple-spindle(inc. screw machines)	2,476	1,819	3,190	2,450	298
Automatic single-spindle (incl. screw machines)	9,543	8,002	5,813	4,187	962
Semi-automatic	1,953	1,604	1,863	1,534	102
Wheel and axle (railroad)	369	314	65	65	611
Turret Lathes					
Ram type	8,190	7,429	8,083	6,245	601
Saddle type	2,636	2,219	6,195	4,786	813
Other Lathes	3,325	2,956	3,516	2,785	566
Milling Machines					
Hand (no power feed)	7,972	7,155	2,829	2,413	203
Bench	924	797	466	302	.....
Knee-type, plain and universal	12,706	10,429	13,924	10,778	1,055
Vertical	1,274	907	3,327	2,481	393
Planer type	505	351	981	813	280
Bed (Lincoln) type	2,461	2,067	2,150	1,889	71
Duplicators and Profilers	1,580	1,416	636	391	55
Continuous (incl. rotary)	31	14	319	251	27
Other	1,288	992	1,541	1,304	266
Pipe Cutting and Threading Machines	922	683	2,345	1,725	1,045
Planers					
Standard	2,900	2,673	3,683	3,354	1,054
Open-side	135	116	531	447	120
Plate and Angle	25	25	64	61	.....
Polishing and Buffing Machines					
Abrasive wheel	10,341	7,193	8,548	5,548	538
Abrasive belt or disk	1,664	958	2,991	1,462	221
Automatic	418	25	2,134	1,141	15
Presses (not forging presses)					
Arbor	6,699	4,207	8,925	6,692	1,013
Crank type	23,351	20,556	29,390	21,029	2,884
Toggle type	797	727	1,482	1,106	277
Hydraulic	850	660	3,281	2,338	745
Other	8,409	6,159	7,893	5,976	1,220
Riveting Machines (not portable)	4,435	3,409	5,793	3,646	513
Shapers					
Horizontal	2,979	2,678	7,154	5,579	1,686
Vertical, including slotters	438	366	1,149	973	87
Shears					
Hand	1,416	1,042	3,355	2,504	787
Power	2,153	1,852	6,318	4,837	2,282
Threading Machines (except for pipe)					
Hobbing and milling	848	729	798	603	17
Die type	877	811	2,277	2,110	951
Tapping	1,357	965	2,091	1,533	218
Welding and Cutting Machines					
Electric arc	2,517	809	8,937	2,568	3,413
Gas	962	192	2,422	1,080	897
Spot	1,103	476	8,042	3,099	486
Resistance (Flash, seam, etc.)	426	105	1,287	722	123
Other Machine Tools	5,985	4,756	12,175	6,074	711
Totals by Regions	**257,038**	**200,508**	**365,504**	**255,424**	**58,092**
Per Cent Over 10 Years Old	**78**		**69**		**73**
Per Cent of Total Equipment in Each Region	**19.7**		**27.9**		**4.4**

1,628	7,756	4,258	659	452	4,814	2,841	158	122	656	507	163	61	27
280	366	106	14	.....	1,218	525	.....	.....	188	79	49	.....	14
361	1,266	1,060	315	265	1,448	1,194	50	32	305	279	98	65	11
4,587	8,324	5,534	499	332	5,743	4,189	17	17	557	380	77	25	.....
9,052	28,013	23,146	5,820	4,994	31,021	25,157	434	397	4,470	3,895	991	827	338
1,819	3,190	2,450	298	200	12,444	9,621	.....	.....	488	311	5	5	.....
8,002	5,813	4,187	962	372	11,476	7,931	14	14	1,195	710	8	8	.....
1,604	1,863	1,534	102	68	2,471	1,727	43	43	638	492	18	18	.....
314	65	65	611	475	38	24	.....	.....	456	415	.....	.....	82
7,429	8,083	6,245	601	379	8,689	7,091	271	271	1,417	1,154	196	119	11
2,219	6,195	4,786	813	592	8,477	6,000	29	11	533	443	288	118	27
2,956	3,516	2,785	566	434	4,165	3,187	63	45	1,062	846	77	16	128
7,155	2,829	2,413	203	124	5,890	4,907	47	47	568	497	30	30	5
797	466	302	.....	.....	758	713	9	9	72	52	.....	.....	.....
0,429	13,924	10,778	1,055	833	11,568	9,710	115	97	1,207	953	105	83	21
907	3,327	2,481	393	312	3,976	3,056	.....	.....	506	388	53	36	52
351	981	813	280	200	1,976	1,556	5	5	302	260	133	91	25
2,067	2,150	1,889	71	57	2,523	2,265	.....	.....	60	46	.....	.....	.....
1,416	636	391	55	41	1,014	809	.....	.....	17	.....	.....	.....	.....
14	319	251	27	27	1,112	563	.....	.....	38	20	.....	.....	.....
992	1,541	1,304	266	231	2,139	1,491	41	41	372	368	25	20	.....
683	2,345	1,725	1,045	724	2,170	1,622	80	80	513	339	304	235	48
2,673	3,683	3,354	1,054	1,005	4,363	3,963	65	47	708	671	135	103	57
116	531	447	120	79	720	623	.....	.....	116	116	33	27	.....
25	64	61	.....	.....	154	154	18	.....	34	34	.....	.....	5
7,193	8,548	5,548	538	431	9,295	6,566	138	76	1,300	949	164	50	14
958	2,991	1,462	221	131	1,943	961	25	.....	209	132	36	5	19
25	2,134	1,141	15	15	450	186	.....	.....	90	76	.....	.....	.....
4,207	8,925	6,692	1,013	879	12,476	9,262	35	35	1,434	1,106	104	19	11
20,556	29,390	21,029	2,884	2,267	52,383	39,703	485	414	2,931	2,165	12	.....	.....
727	1,482	1,106	277	277	2,141	1,761	.....	.....	152	127	33	25	11
660	3,281	2,338	745	672	3,028	1,384	65	29	1,127	750	130	77	66
6,159	7,893	5,976	1,220	946	5,187	4,091	9	9	594	192	271	223	128
3,409	5,793	3,646	513	462	9,422	4,933	111	61	835	676	113	113	14
2,678	7,154	5,579	1,686	1,422	9,542	7,687	213	213	1,430	1,178	216	194	70
366	1,149	973	87	71	1,088	1,072	41	5	276	240	.....	.....	19
1,042	3,355	2,504	787	492	3,750	2,964	196	175	813	643	215	164	43
1,852	6,318	4,837	2,282	1,940	8,198	5,982	248	193	2,078	1,608	503	435	112
729	798	603	17	15	1,171	827	.....	.....	39	14	57	16	.....
811	2,277	2,110	951	862	2,763	1,894	102	66	465	418	137	126	79
965	2,091	1,533	218	173	5,638	4,306	.....	.....	517	355	.....	.....	5
809	8,937	2,568	3,413	952	12,871	3,086	453	134	3,788	1,089	986	311	262
192	2,422	1,080	897	179	3,388	1,214	96	17	1,322	201	240	22	289
476	8,042	3,099	486	358	15,217	7,471	42	42	657	250	36	11	5
105	1,287	722	123	123	2,339	694	.....	.....	29	20	.....	.....	.....
4,756	12,175	6,074	711	555	18,674	10,043	36	.....	1,730	1,371	249	81	.....
0,508	**365,504**	**255,424**	**58,092**	**42,631**	**514,844**	**353,273**	**6,935**	**4,980**	**66,172**	**47,342**	**11,480**	**7,402**	**3,699**
	69		**73**		**69**		**72**		**72**		**64**		**68**
	27.9		**4.4**		**39.1**		**0.5**		**5.0**		**0.9**		**0.3**

7	.....	668	332
4	14	7	2
1	11	107	40
.	.....	245	115
8	314	1,628	1,215
.	.....	11	11
.	.....	358	184
.	.....	.....	.....
2	68	32	19
1	11	353	158
7	22	461	278
8	73	122	107
5	5	230	147
.	.....	41	41
1	21	372	261
2	52	299	160
5	25	41	36
..	.....	.....	.....
..	.....	3	3
..	.....	.....	.....
..	.....	8	.....
48	30	370	208
57	57	204	179
.	.....	11	11
5	5	.....	.....
14	.....	899	442
19	5	165	27
..	.....	25	25
11	11	580	413
..	.....	2,660	1,360
11	11	285	121
66	52	329	178
28	128	617	516
14	.....	446	294
70	56	629	514
19	19	17	17
43	43	590	387
12	112	1,018	581
..	.....	10	5
79	60	106	79
5	.....	79	50
62	107	1,419	348
89	19	416	116
5	.....	684	232
..	.....	196	131
..	.....	381	162
99	**2,522**	**28,837**	**16,252**
68		**56**	
0.3		**2.2**	

Production Equipment

	1		2		3		4		5	
	Agricultural Implements		Aircraft and Aircraft Engines		Motor Vehicles		Motor Vehicle Bodies and Parts		Construction M ing and Oil-We Equipment	
	Total Units Now in Place	Units Over 10 Years Old	Total Units Now in Place	Units Over 10 Years Old	Total Units Now in Place	Units Over 10 Years Old	Total Units Now in Place	Units Over 10 Years Old	Total Units Now in Place	Units O 10 Yea Old
Bending Machines										
Apron and Press Brakes	223	95	140	38	599	479	552	329	147	1
Bending, Straightening and Forming Rolls	260	194	145	40	599	287	725	396	201	1
Pipe and Bar	28	10	51	22	96	60	121	43	76	
Other	38	33	52	24	132	36	190	17	32	
Boring Machines										
Horizontal Boring, Drilling and Milling	213	161	28	14	539	120	501	199	395	3
Vertical Boring Mills	294	228	2	2	431	263	121	104	657	5
Precision, Horizontal and Vertical	237	81	35	2	503	168	190	104	42	
Jig	*19*	*9*	*35*	*5*	*60*	*48*	*155*	*78*	26	
Other	.....	.....	.....	.....	.....	.....	.....	.....	*16*	
Broaching Machines										
Horizontal	162	124	13	2	515	371	173	138	80	
Vertical	90	10	10	2	527	84	234	35	16	
Cutting-off Machines										
Bandsaw	118	61	251	95	503	323	716	422	197	
Rotary hot or cold saw	123	71	102	13	275	263	209	139	130	1
Hacksaw	330	256	72	15	335	239	733	381	760	4
Abrasive disk	33	23	31	2	132	84	104	26	75	
Other	33	33	18	.....	192	156	207	9	21	
Drilling Machines										
Upright:										
Single-spindle	2,236	1,588	704	285	6,213	4,166	5,938	4,247	1,589	1,2
Multiple-spindle	958	550	196	60	1,281	754	2,589	1,752	256	1
Sensitive:										
Single-spindle	716	308	570	137	2,885	2,454	1,227	691	339	2
Multiple-spindle	251	185	452	174	1,592	1,149	1,709	940	54	
Radial	1,019	573	319	133	958	898	415	199	1,069	6
Special Purpose, Single and Multiple Spindle	327	109	112	20	3,196	766	578	146	16	
Centering machines	57	48	.....	.....	356	227	87	78	80	
Other	19	19	63	.....	431	287	95	26	32	
Forging Machines										
Bulldozers	351	327	2	.....	84	48	398	295	136	
Hammers:										
Board and Rope Drop	289	285	18	.....	132	132	78	69	31	
Steam or air operated	57	29	35	.....	395	215	35	35	301	2
Other power hammers	100	100	24	16	215	204	224	224	124	1
Forging presses	15	15	.....	.....	108	.....	9	.....	59	
Forging machines (upsetting)	52	52	2	.....	275	108	26	.....	92	
Swaging machines	5	5	8	2	24	12	103	52	15	
Other	24	24	6	.....	120	12	26	17	48	
Gear-Cutting Machines										
Formed rotary-cutter type:										
Spur and helical	42	28	2	2	1,317	718	78	43	157	1
Bevel	19	14	8	.....	60	60	26	17	10	
Generators:										
Shaper type	185	147	123	10	84	84	.....	.....	49	
Bevel, spiral bevel and hypoid	90	57	8	6	1,341	395	26	26	48	
Herringbone	.....	.....	.....	.....	.....	.....	26	26	33	
Hobbing	322	209	79	20	2,933	754	518	207	70	
Shaving and finishing	9	.....	63	.....	1,712	407	.....	.....	5	
Other	33	19	.....	.....	1,101	215	26	26	27	
Grinding Machines										
Cutter and tool	569	337	312	67	3,148	2,346	1,182	803	608	4
Drill	86	38	38	10	419	371	251	129	244	1
Floor (pedestal type)	1,308	1,195	299	36	3,088	2,550	3,287	2,133	1,281	8
External cylindrical, plain and universal	427	275	247	79	3,292	1,843	1,192	898	212	1
Internal cylindrical	161	109	305	74	970	599	233	190	118	
Surface, horizontal and vertical	165	89	183	44	1,221	922	1,622	1,165	141	
Disk, horizontal and vertical	81	67	102	8	383	275	665	415	146	1
Thread	5	5	60	.....	48	36	9	.....	16	
Gear tooth	.....	.....	79	.....	24	.....	.....	.....	10	
Centerless	47	38	32	10	1,113	754	242	121	15	.....
Other	388	307	22	6	1,077	778	466	285	131	
Honing and Lapping Machines	71	28	76	5	239	36	224	60	81	
	70	60	.....	.....	120	120	78	61	322	2

5/31/40

AMERICAN MACHINIST 1940 Inventory of Metal-V

By Twenty Industrial Divisions

5		6		7		8		9		10		11		12	
tion Min-Oil-Well ment		Materials Handling and Power Transmission Equipment		Domestic Electrical Appliances and Equipment		Industrial and Commercial Electrical Equipment		Engines, Turbines and Water Wheels		Fabricated Metal Products		Food and Chemical Processing Equipment		Precision Mechanisms	
Units Over 10 Years Old		Total Units Now in Place	Units Over 10 Years Old	Total Units Now in Place	Units Over 10 Years Old	Total Units Now in Place	Units Over 10 Years Old	Total Units Now in Place	Units Over 10 Years Old	Total Units Now in Place	Units Over 10 Years Old	Total Units Now in Place	Units Over 10 Years Old	Total Units Now in Place	Units Over 10 Years Old
103		337	230	244	93	490	307	69	36	7,979	4,658	258	142	220	100
163		420	362	233	82	567	417	114	99	4,707	2,996	155	123	212	110
53		108	45	349	23	146	95	28	18	1,509	1,007	154	84	101	59
16		201	166	.....	.....	37	14	.....	.....	2,845	1,308	.....	.....	59	42
338		776	621	12	.....	208	165	589	509	1,560	1,384	103	38	126	83
598		904	767	12	12	671	592	454	365	1,862	1,585	136	110	246	212
37		88	58	12	12	297	104	57	24	378	277	110	77	34	8
5		44	20	35	12	75	66	13	12	201	.....	25	13	67	.....
11		15	15	.....	.....	24	14	96	30	126	100	.....	.....	.....	.....
80		172	118	12	12	155	118	52	42	353	277	51	38	42	16
5		30	20	23	23	28	19	18	3	529	478	19	12	41	16
92		294	200	105	47	708	544	138	105	4,356	2,165	181	103	321	100
108		176	142	23	.....	189	151	33	33	1,384	1,083	78	71	144	93
400		815	591	163	151	620	459	263	138	7,628	5,789	426	290	588	262
16		98	64	.....	.....	100	62	39	9	1,411	554	26	6	178	33
10		44	25	35	35	322	251	18	15	604	378	.....	.....	51	25
1,293		2,162	1,708	1,083	826	2,293	1,797	640	530	36,094	26,351	1,155	968	3,146	1,721
175		674	528	442	396	1,367	1,069	297	210	11,376	8,910	239	207	1,781	1,313
203		688	503	1,432	1,083	1,822	1,235	335	242	11,226	6,116	685	458	2,026	753
49		410	375	687	663	2,063	1,688	150	93	2,466	2,089	361	329	634	466
691		1,158	815	70	58	903	799	702	470	3,927	3,222	671	432	194	141
5		74	65	70	63	544	340	108	36	2,265	1,359	.....	.....	126	5
64		157	118	.....	.....	61	48	48	36	554	528	26	19	84	53
5		64	49	12	12	128	80	21	21	579	479	348	232	187	5
97		89	84	.....	.....	19	19	9	6	528	503	12	12	.....	.....
31		15	10	.....	.....	19	19	24	24	2,719	2,593	.....	.....	50	5
229		103	98	12	12	71	66	54	36	982	680	6	6	17	.....
124		55	55	5	.....	52	52	9	9	1,585	1,484	102	102	42	.....
48		5	5	.....	.....	14	9	9	9	630	554	.....	.....	.....	.....
92		15	10	.....	.....	19	14	42	42	982	931	.....	.....	.....	.....
15		.....	.....	58	5	14	14	3	.....	855	604	.....	.....	76	5
48		5	5	5	.....	14	9	.....	.....	1,888	1,032	6	6	59	3
141		591	449	163	163	33	33	60	57	352	302	110	90	185	13
10		73	58	.....	.....	.....	.....	.....	.....	704	126	70	57	8	
38		396	263	.....	.....	52	52	54	30	125	125	77	43	17	1
37		147	127	.....	.....	.....	.....	45	18	.....	.....	31	19	34	
5		122	63	.....	.....	.....	.....	.....	.....	76	76	.....	.....	.....	.....
43		469	308	47	47	75	61	236	150	252	101	84	51	177	3
5		10	.....	.....	.....	.....	.....	15	6	.....	.....	.....	.....	.....	.....
5		97	83	.....	.....	14	14	18	.....	504	378	.....	.....	34	.....
426		820	495	186	186	888	648	394	228	8,230	5,865	406	225	1,220	75
156		371	225	23	23	147	48	72	30	2,642	1,610	239	121	347	1
887		1,713	1,357	513	408	2,219	1,888	624	524	16,890	13,012	857	619	1,602	9
162		531	411	442	407	904	714	254	179	3,298	2,567	263	187	662	5
92		229	166	12	12	227	170	87	66	805	604	64	45	712	4
91		356	254	279	210	959	678	225	144	6,797	4,153	225	141	847	4
114		302	234	151	128	379	355	138	123	2,995	2,214	174	122	348	2
10		25	10	.....	.....	.....	.....	3	.....	75	75	6	6	.....	.....
10		5	5	.....	.....	.....	.....	3	3	.....	.....	.....	.....	.....	.....
.....		34	20	.....	.....	99	57	12	3	755	403	25	19	263	1
15		201	108	105	58	620	341	240	162	4,681	3,172	316	193	2,196	1,1
16		171	39	.....	.....	193	109	39	15	503	327	19	13	117	
278		523	371	.....	.....	146	113	54	48	528	428	218	154	42	

5/31/40

AMERICAN MACHINIST 1940 Invento

By Twenty Industri

4		5		6		7		8		9		10		
Motor Vehicle Bodies and Parts		Construction Mining and Oil-Well Equipment		Materials Handling and Power Transmission Equipment		Domestic Electrical Appliances and Equipment		Industrial and Commercial Electrical Equipment		Engines, Turbines and Water Wheels		Fabricated Metal Products		Fo
otal Units Now in Place	Units Over 10 Years Old	Total Units Now in Place	Units Over 10 Years Old	Total Units Now in Place	Units Over 10 Years Old	Total Units Now in Place	Units Over 10 Years Old	Total Units Now in Place	Units Over 10 Years Old	Total Units Now in Place	Units Over 10 Years Old	Total Units Now in Place	Units Over 10 Years Old	To N
552	329	147	103	337	230	244	93	490	307	69	36	7,979	4,658	
725	396	201	163	420	362	233	82	567	417	114	99	4,707	2,996	
121	43	76	53	108	45	349	23	146	95	28	18	1,509	1,007	
190	17	32	16	201	166	.....	.....	37	14	.....	.....	2,845	1,308	..
501	199	395	338	776	621	12	.....	208	165	589	509	1,560	1,384	
121	104	657	598	904	767	12	12	671	592	454	365	1,862	1,585	
190	104	42	37	88	58	12	12	297	104	57	24	378	277	
155	78	26	5	44	20	35	12	75	66	13	12	201	.....	
.....	.....	16	11	15	15	.....	.....	24	14	96	30	126	100	..
173	138	80	80	172	118	12	12	155	118	52	42	353	277	
234	35	16	5	30	20	23	23	28	19	18	3	529	478	
716	422	197	92	294	200	105	47	708	544	138	105	4,356	2,165	
209	139	130	108	176	142	23	.....	189	151	33	33	1,384	1,083	
733	381	760	400	815	591	163	151	620	459	263	138	7,628	5,789	
104	26	75	16	98	64	.....	.....	100	62	39	9	1,411	554	
207	9	21	10	44	25	35	35	322	251	18	15	604	378	..
5,938	4,247	1,589	1,293	2,162	1,708	1,083	826	2,293	1,797	640	530	36,094	26,351	
2,589	1,752	256	175	674	528	442	396	1,367	1,069	297	210	11,376	8,910	
1,227	691	339	203	688	503	1,432	1,083	1,822	1,235	335	242	11,226	6,116	
1,709	940	54	49	410	375	687	663	2,063	1,688	150	93	2,466	2,089	
415	199	1,069	691	1,158	815	70	58	903	799	702	470	3,927	3,222	
578	146	16	5	74	65	70	63	544	340	108	36	2,265	1,359	..
87	78	80	64	157	118	.....	.....	61	48	48	36	554	528	
95	26	32	5	64	49	12	12	128	80	21	21	579	479	
398	295	136	97	89	84	.....	.....	19	19	9	6	528	503	
78	69	31	31	15	10	.....	.....	19	19	24	24	2,719	2,593	..
35	35	301	229	103	98	12	12	71	66	54	36	982	680	
224	224	124	124	55	55	5	.....	52	52	9	9	1,585	1,484	
9	.....	59	48	5	5	.....	.....	14	9	9	9	630	554	..
26	.....	92	92	15	10	.....	.....	19	14	42	42	982	931	..
103	52	15	15	.....	.....	58	5	14	14	3	.....	855	604	..
26	17	48	48	5	5	5	.....	14	9	.....	.....	1,888	1,032	
78	43	157	141	591	449	163	163	33	33	60	57	352	302	
26	17	10	10	73	58	.....	.....	.....	.....	.....	.....	704	126	
.....	.....	49	38	396	263	.....	.....	52	52	54	30	125	125	
26	26	48	37	147	127	.....	.....	.....	.....	45	18	.....	.....	
26	26	33	5	122	63	.....	.....	.....	.....	.....	.....	76	76	..
518	207	70	43	469	308	47	47	75	61	236	150	252	101	..
.....	.....	5	5	10	.....	.....	.....	.....	.....	15	6	.....	.....	..
26	26	27	5	97	83	.....	.....	14	14	18	.....	504	378	..
1,182	803	608	426	820	495	186	186	888	648	394	228	8,230	5,865	
251	129	244	156	371	225	23	23	147	48	72	30	2,642	1,610	
3,287	2,133	1,281	887	1,713	1,357	513	408	2,219	1,888	624	524	16,890	13,012	
1,192	898	212	162	531	411	442	407	904	714	254	179	3,298	2,567	
233	190	118	92	229	166	12	12	227	170	87	66	805	604	
1,622	1,165	141	91	356	254	279	210	959	678	225	144	6,797	4,153	
665	415	146	114	302	234	151	128	379	355	138	123	2,995	2,214	
9	.....	16	10	25	10	.....	.....	.....	.....	3	.....	75	75	
.....	.....	10	10	5	5	.....	.....	.....	.....	3	3	.....	.....	..
241	121	15	.....	34	20	.....	.....	99	57	12	3	755	403	
466	285	131	15	201	108	105	58	620	341	240	162	4,681	3,172	
224	60	81	16	171	39	.....	.....	193	109	39	15	503	327	
78	61	322	278	523	371	.....	.....	146	113	54	48	528	428	

ntory of Metal-Working Equipment

ıstrial Divisions

	11		12		13		14		15		16		17	
	Food and Chemical Processing Equipment		Precision Mechanisms		Machinery Not Otherwise Classified		Metal-Working Machinery		Business Machines		Army Arsenals		Heavy Equipment Not Otherwise Classified	
Over ars d	Total Units Now in Place	Units Over 10 Years Old	Total Units Now in Place	Units Over 10 Years Old	Total Units Now in Place	Units Over 10 Years Old	Total Units Now in Place	Units Over 10 Years Old	Total Units Now in Place	Units Over 10 Years Old	Total Units Now in Place	Units Over 10 Years Old	Total Units Now in Place	Units Over 10 Years Old
658	258	142	220	100	157	86	127	93	53	24	15	12	1,177	813
996	155	123	212	110	227	121	431	294	68	30	39	27	1,971	1,766
007	154	84	101	59	104	34	74	40	9	6	2	1	1,076	651
308	.....	.....	59	42	87	52	20	15	12	.....	12	6	223	182
384	103	38	126	83	525	437	1,122	716	9	6	306	261	1,056	833
585	136	110	246	212	1,030	995	470	383	.....	.....	123	85	1,443	1,300
277	110	77	34	8	52	.....	89	59	3	.....	16	15	20	.....
...	25	13	67	.....	34	17	192	83	48	15	18	2	20	20
100	.....	.....	.....	.....	.....	.....	59	40	6	3	20	8	20	20
277	51	38	42	16	86	69	304	236	24	6	42	27	346	182
478	19	12	41	16	104	52	40	20	12	.....	.....	.....	102	20
165	181	103	321	100	506	349	471	294	62	27	47	25	1,483	893
083	78	71	144	93	157	139	407	289	36	15	65	62	955	773
789	426	290	588	262	749	558	809	452	82	57	107	72	2,477	1,687
554	26	6	178	33	209	51	133	54	9	3	9	3	406	163
378	.....	.....	51	25	139	104	760	633	127	21	27	17	305	183
351	1,155	968	3,146	1,721	2,829	2,480	2,724	2,087	441	322	763	746	5,745	4,792
910	239	207	1,781	1,315	524	402	1,695	1,348	1,299	1,024	48	26	467	284
116	685	458	2,026	755	960	785	1,396	881	438	261	332	218	1,380	609
089	361	329	634	466	733	367	1,049	730	556	494	141	78	528	426
222	671	432	194	143	1,152	943	1,715	1,015	42	18	176	168	2,781	2,233
359	.....	.....	126	51	209	34	152	143	53	39	201	167	487	467
528	26	19	84	59	104	104	334	285	6	3	44	35	263	243
479	348	232	187	51	52	35	195	147	56	12	18	8	224	81
503	12	12	.....	.....	17	17	40	40	.....	.....	4	4	752	690
593	.....	.....	50	50	.....	.....	137	94	18	6	98	91	2,295	2,092
680	6	6	17	.....	122	122	89	64	.....	.....	37	35	1,402	1,076
484	102	102	42	.....	121	121	182	157	24	9	21	21	448	365
554	.....	.....	.....	.....	17	17	45	35	.....	.....	10	10	244	244
931	.....	.....	.....	.....	.....	.....	5	5	.....	.....	4	3	406	406
504	.....	.....	76	51	.....	.....	157	113	3	3	.....	.....	568	448
032	6	6	59	33	.....	.....	117	98	.....	.....	1	1	161	121
302	110	90	185	135	366	349	808	637	56	56	16	11	121	121
126	70	57	8	8	70	17	137	108	21	15	16	13	81	40
125	77	43	17	17	69	34	314	230	3	.....	20	8	20	20
...	31	19	34	8	.....	.....	103	88	.....	.....	.....	.....	20	20
76	.....	.....	.....	.....	.....	.....	5	5	.....	.....	1	.....	.....	.....
101	84	51	177	50	69	35	700	324	123	71	34	10	40	40
...	.....	.....	.....	.....	.....	.....	69	29	.....	.....	.....	.....	.....	.....
378	.....	.....	34	.....	.....	.....	63	15	29	21	12	4	61	.....
365	406	225	1,220	754	839	559	3,117	2,043	440	336	472	331	1,482	1,015
610	239	121	347	118	489	244	505	246	42	15	38	10	690	406
012	857	619	1,602	941	1,920	1,065	1,862	1,333	465	285	399	325	5,562	4,181
567	263	187	662	509	454	349	2,789	1,848	144	91	302	248	448	223
604	64	45	712	458	87	52	784	579	33	6	64	49	40	40
153	225	141	847	491	768	506	3,062	1,672	573	319	289	187	588	455
214	174	122	348	263	104	69	883	662	153	62	41	30	365	244
75	6	6	.....	.....	.....	.....	432	191	3	.....	11	2	20	.....
...	.....	.....	.....	.....	.....	.....	240	49	.....	.....	4	.....	.....	.....
403	25	19	263	135	.....	.....	99	59	12	6	10	1	202	101
172	316	193	2,196	1,144	453	261	1,725	1,421	353	121	254	175	2,396	549
227	19	13	117	42	.....	.....	274	171	18	6	109	75	.....	.....
428	218	154	42	42	384	349	323	251	3	3	18	15	405	385

pment

ing y	Over ears ld	15 Business Machines		16 Army Arsenals		17 Heavy Equipment Not Otherwise Classified		18 Railroad Equipment		19 Job-Shop Products		20 Textile and Clothing Machinery		Machine Totals		Per Cent Over Ten Years Old
		Total Units Now in Place	Units Over 10 Years Old	Total Units Now in Place	Units Over 10 Years Old	Total Units Now in Place	Units Over 10 Years Old	Total Units Now in Place	Units Over 10 Years Old	Total Units Now in Place	Units Over 10 Years Old	Total Units Now in Place	Units Over 10 Years Old	Total Units Now in Place	Units Over 10 Years Old	
	93	53	24	15	12	1,177	813	643	493	217	145	115	45	**13,762**	**8,321**	**61**
	294	68	30	39	27	1,971	1,766	1,162	1,011	217	145	115	71	**12,568**	**8,734**	**69**
	40	9	6	2	1	1,076	651	560	505	126	72	18	.....	**4,736**	**2,828**	**60**
	15	12	.....	12	6	223	182	206	206	109	109	617	352	**4,872**	**2,578**	**53**
	716	9	6	306	261	1,056	833	629	478	1,125	927	80	71	**9,902**	**7,361**	**74**
	383	.....	.....	123	85	1,443	1,300	1,859	1,601	962	888	132	124	**11,809**	**10,214**	**86**
	59	3	.....	16	15	20	.....	205	164	91	18	9	.....	**2,468**	**1,208**	**49**
	83	48	15	18	2	20	20	1,025	478	435	218	44	18	**2,571**	**1,119**	**44**
	40	6	3	20	8	20	20	123	110	54	54	.....	.....	**559**	**405**	**72**
	236	24	6	42	27	346	182	41	28	181	144	27	18	**2,831**	**2,046**	**72**
	20	12	.....	.....	.....	102	20	14	.....	54	18	9	9	**1,900**	**826**	**43**
	294	62	27	47	25	1,483	893	259	192	780	290	220	97	**11,716**	**6,424**	**55**
	289	36	15	65	62	955	773	615	574	162	126	26	18	**5,289**	**4,163**	**78**
	452	82	57	107	72	2,477	1,687	929	671	1,397	1,016	362	273	**19,645**	**13,757**	**70**
	54	9	3	9	3	406	163	150	96	199	108	44	18	**3,386**	**1,375**	**40**
	633	127	21	27	17	305	183	96	69	18	.....	44	27	**3,061**	**1,991**	**65**
	087	441	322	763	746	5,745	4,792	2,926	2,516	4,229	3,195	1,928	1,269	**84,838**	**62,887**	**74**
	348	1,299	1,024	48	26	467	284	383	329	854	636	969	890	**27,695**	**20,865**	**75**
	881	438	261	332	218	1,380	609	1,354	985	2,194	1,288	405	255	**32,410**	**19,467**	**60**
	730	556	494	141	78	528	426	55	41	254	199	291	273	**14,436**	**10,808**	**74**
	015	42	18	176	168	2,781	2,233	1,873	1,544	1,470	1,089	397	335	**21,011**	**15,778**	**75**
	143	53	39	201	167	487	467	287	233	199	145	62	53	**9,066**	**4,241**	**47**
	285	6	3	44	35	263	243	412	316	145	127	70	52	**2,888**	**2,390**	**83**
	147	56	12	18	8	224	81	115	112	36	.....	432	308	**3,107**	**1,964**	**63**
	40	.....	.....	4	4	752	690	437	424	36	18	.....	.....	**2,914**	**2,584**	**89**
	94	18	6	98	91	2,295	2,092	204	177	54	54	61	26	**6,242**	**5,753**	**92**
	64	.....	.....	37	35	1,402	1,076	1,681	1,640	199	199	.....	.....	**5,598**	**4,542**	**81**
	157	24	9	21	21	448	365	533	505	216	198	9	.....	**4,091**	**3,746**	**91**
	35	.....	.....	10	10	244	244	96	96	18	18	36	36	**1,315**	**1,096**	**83**
	5	.....	.....	4	3	406	406	860	805	.....	.....	.....	.....	**2,780**	**2,468**	**89**
	113	3	3	.....	.....	568	448	82	69	.....	.....	18	18	**1,989**	**1,411**	**71**
	98	.....	.....	1	1	161	121	110	82	.....	.....	18	18	**2,608**	**1,506**	**58**
	537	56	56	16	11	121	121	96	96	217	181	80	62	**4,850**	**3,674**	**76**
	108	21	15	16	13	81	40	14	.....	72	54	9	9	**1,398**	**606**	**43**
	230	3	.....	20	8	20	20	.....	.....	217	162	53	35	**1,858**	**1,298**	**67**
	188	.....	.....	.....	.....	20	20	.....	.....	108	54	27	18	**2,026**	**873**	**43**
	5	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	9	9	**272**	**184**	**68**
	324	123	71	34	10	40	40	28	14	127	109	44	26	**6,427**	**2,630**	**41**
	129	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	**1,883**	**447**	**23**
	115	29	21	12	4	61	.....	.....	.....	18	18	.....	.....	**2,037**	**798**	**39**
	443	440	336	472	331	1,482	1,015	1,680	1,449	1,451	907	652	387	**28,096**	**19,407**	**69**
	146	42	15	38	10	690	406	301	266	471	271	212	124	**7,627**	**4,461**	**58**
	833	465	285	399	325	5,562	4,181	4,347	3,705	1,866	1,470	546	414	**50,648**	**38,328**	**75**
	448	144	91	302	248	448	223	520	355	1,325	925	229	88	**17,935**	**12,358**	**69**
	79	33	6	64	49	40	40	438	355	744	490	53	35	**6,166**	**4,191**	**66**
	772	573	319	289	187	588	455	342	261	2,086	1,107	740	467	**21,468**	**13,346**	**62**
	462	153	62	41	30	365	244	151	138	491	290	97	79	**8,149**	**5,892**	**72**
	91	3	.....	11	2	20	.....	.....	.....	54	.....	.....	.....	**767**	**335**	**41**
	49	.....	.....	4	.....	.....	.....	14	14	73	.....	9	9	**461**	**90**	**17**
	259	12	6	10	1	202	101	28	.....	73	73	44	18	**3,105**	**1,818**	**58**
	721	353	121	254	175	2,396	549	669	438	980	654	18	18	**17,291**	**10,206**	**59**
	71	18	6	109	75	.....	.....	28	14	180	36	71	18	**2,413**	**1,010**	**41**
	51	3	3	18	15	405	385	179	151	507	399	79	79	**3,999**	**3,307**	**83**

Internal cylindrical	161	109	305	74	970	599	233	190	118	92	
Surface, horizontal and vertical	165	89	183	44	1,221	922	1,622	1,165	141	91	
Disk, horizontal and vertical	81	67	102	8	383	275	665	415	146	114	
Thread	5	5	60	.....	48	36	9	.....	16	10	
Gear tooth	.....	.....	79	.....	24	.....	.....	.....	10	10	
Centerless	47	38	32	10	1,113	754	242	121	15	.....	
Other	388	307	22	6	1,077	778	466	285	131	15	
Honing and Lapping Machines	71	28	76	5	239	36	224	60	81	16	
Keyseaters	70	60	.....	.....	120	120	78	61	322	278	
Lathes											
Bench	56	37	230	54	192	168	2,149	1,778	64	15	
Engine (incl. toolroom)	1,044	840	438	160	4,345	3,208	4,532	3,849	2,818	2,428	3,
Automatic multiple-spindle (incl. screw machines)	185	161	215	54	3,172	1,676	1,571	1,303	81	60	
Automatic single-spindle (incl. screw machines)	445	137	351	84	1,604	359	3,263	2,710	86	75	
Semi-automatic	436	218	6	2	563	515	354	354	43	16	
Wheel and axle (railroad)	5	5	.....	.....	.....	.....	.....	.....	15	15	
Turret Lathes:											
Ram type	303	294	229	60	886	730	898	837	377	240	
Saddle type	763	630	501	213	682	551	544	483	930	645	1,
Other Lathes	190	124	28	22	898	634	881	535	223	119	
Milling Machines											
Hand (no power feed)	190	110	90	46	658	551	1,226	1,054	75	75	
Bench	14	14	.....	.....	24	12	363	354	16	14	
Knee-type, plain and universal	788	565	542	201	1,400	1,640	1,563	1,216	624	536	1,
Vertical	99	75	283	66	599	479	690	483	125	81	
Planer type	71	62	40	25	287	168	250	164	207	174	
Bed (Lincoln) type	28	28	8	6	180	48	190	190	33	33	
Duplicators and Profilers	10	10	48	13	227	192	69	9	.....	.....	
Continuous (incl. rotary)	90	71	14	2	599	311	138	9	27	16	
Other	247	110	.....	.....	898	670	345	328	32	27	
Pipe Cutting and Threading Machines	91	76	12	.....	192	132	164	78	344	246	
Planers											
Standard	151	147	8	2	263	227	225	182	503	481	
Open-side	.....	.....	6	.....	60	48	35	26	75	64	
Plate and Angle	5	5	.....	.....	.....	.....	.....	.....	10	10	
Polishing and Buffing Machines											
Abrasive wheel	261	246	313	79	646	599	2,072	648	190	70	
Abrasive belt or disk	28	23	85	18	84	72	475	86	58	37	
Automatic	.....	.....	14	10	24	12	864	104	.....	.....	
Presses (not forging presses)											
Arbor	654	459	256	125	2,406	1,915	2,193	1,433	300	186	1,
Crank type	1,276	1,048	229	74	5,267	4,345	18,787	13,196	301	241	1,
Toggle type	28	23	59	35	299	287	673	371	126	76	
Hydraulic	318	90	56	13	718	311	561	61	284	201	
Other	156	57	13	2	1,317	1,017	758	673	31	26	
Riveting Machines (not portable)	422	256	199	22	754	467	3,392	1,321	92	87	
Shapers											
Horizontal	289	256	94	26	730	646	1,217	889	508	431	
Vertical, including slotters	91	67	8	8	144	132	207	138	148	64	
Shears											
Hand	57	28	225	139	251	251	397	164	158	156	
Power	332	256	117	43	599	407	1,191	795	432	344	
Threading Machines (except for pipe)											
Hobbing and milling	57	19	62	20	275	144	190	129	24	21	
Die type	199	166	26	8	575	431	164	86	173	118	
Tapping	133	94	52	12	850	694	1,200	863	48	22	
Welding and Cutting Machines											
Electric arc	719	93	46	5	1,054	395	2,744	526	1,977	404	1,4
Gas	71	24	543	.....	48	36	311	95	454	131	
Spot	162	52	28	2	2,274	1,065	5,930	2,730	86	48	
Resistance (Flash, seam, etc.)	38	19	16	2	251	72	1,389	285	10	.....	
Other Machine Tools	574	370	26	.....	10,270	4,740	2,606	1,596	290	125	
Totals by Industrial Divisions	**23,831**	**15,993**	**11,050**	**3,133**	**93,961**	**58,033**	**95,390**	**59,927**	**23,234**	**15,903**	**35,4**
Per Cent Over 10 Years Old	**67**		**28**		**62**		**63**		**69**		
Per Cent of Total Equipment in Each Industrial Division	**1.8**		**0.8**		**7.1**		**7.2**		**1.8**		

92	229	166	12	12	227	170	87	66							
91	356	254	279	210	959	678	225	144	6,797	4,153	225	141	847	491	768
14	302	234	151	128	379	355	138	123	2,995	2,214	174	122	348	263	104
10	25	10	.....	.....	.....	.....	3	.....	75	75	6	6	.....	.....	.....
10	5	5	.....	.....	.....	.....	3	3	.....	.....	.....	.....	.....	.....	.....
..	34	20	.....	.....	99	57	12	3	755	403	25	19	263	135	.....
15	201	108	105	58	620	341	240	162	4,681	3,172	316	193	2,196	1,144	453
16	171	39	.....	.....	193	109	39	15	503	327	19	13	117	42	.....
78	523	371	.....	.....	146	113	54	48	528	428	218	154	42	42	384
5	191	137	326	279	501	360	24	21	8,432	6,493	419	309	2,891	1,586	768
28	3,582	2,952	745	698	3,586	2,950	1,163	963	29,802	25,623	1,774	1,432	3,841	2,831	4,277
50	308	219	105	81	578	412	93	75	10.144	8,457	71	45	729	492	52
75	448	380	780	535	885	530	215	197	13,843	11,226	425	206	2,392	1,535	437
6	327	244	81	35	1,348	984	317	176	2,014	1,736	32	19	399	279	52
5	10	10	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
0	893	548	745	698	1,477	1,093	239	156	14,424	13,314	626	368	1,585	780	629
5	1,439	977	198	198	752	506	627	434	5,789	4,455	458	290	1,017	721	855
9	137	118	23	23	715	573	39	39	5,815	4,859	161	148	356	305	297
5	265	206	175	151	629	515	141	111	9,943	9,037	154	108	754	550	209
4	5	5	70	70	14	10	.....	.....	1,032	881	.....	.....	228	152	52
6	1,046	846	512	466	1,509	1,235	574	415	11,226	9,389	1,676	1,263	1,713	1,212	2,374
1	273	220	81	58	774	664	129	102	2,089	1,559	296	142	348	204	314
4	274	215	105	81	99	89	239	167	957	881	52	45	118	67	139
3	59	54	23	23	71	71	48	3	1,837	1,636	187	181	695	695	34
.	10	5	12	12	113	61	21	9	982	881	45	19	297	186	174
6	29	29	.....	.....	.....	.....	33	12	277	202	.....	.....	.....	.....	17
7	83	49	12	12	52	38	126	36	1,889	1,485	90	84	203	135	52
6	245	187	23	12	274	184	60	39	2,567	2,013	83	37	74	25	139
1	368	348	12	.....	198	169	236	230	3,045	2,819	344	251	127	109	1,259
4	74	59	12	.....	90	62	.....	.....	353	328	18	18	8	8	104
0	5	5	.....	.....	.....	.....	6	3	100	100	.....	.....	.....	.....	.....
0	317	268	1,746	1,467	785	402	90	72	18,048	12,258	374	155	865	560	558
7	162	83	81	35	364	260	30	12	3,625	1,838	12	6	416	160	314
.	20	20	.....	.....	19	.....	.....	.....	755	252	.....	.....	823	611	.....
6	1,102	840	1,257	966	2,099	1,575	287	200	10,672	6,998	910	774	1,501	907	891
1	1,089	967	3,352	2,340	5,657	4,484	413	332	61,968	48,227	290	225	2,315	1,578	646
6	49	49	70	47	94	79	3	3	2,617	2,315	32	.....	348	170	17
1	361	234	245	140	1,850	1,273	177	114	1,360	781	90	44	161	59	157
6	249	190	698	466	1,746	1,311	63	33	12,258	7,978	84	19	746	424	244
7	235	215	1,886	617	1,343	709	57	33	8,758	6,696	64	45	788	271	226
	542	487	245	221	649	545	252	150	8,710	7,098	296	289	551	414	908
	69	64	46	35	217	188	87	75	706	528	19	19	24	24	122
	293	230	47	23	360	283	105	96	5,588	4,280	347	257	594	398	279
	528	415	337	209	1,504	1,003	156	135	10,068	7,575	258	187	169	92	209
	185	113	12	12	123	80	27	15	479	479	39	39	169	85	87
	201	176	12	.....	75	57	81	69	2,793	2,341	44	31	76	51	157
	141	113	407	303	870	709	105	66	3,776	2,971	45	44	491	287	140
	1,434	450	314	128	2,035	885	424	90	6,971	1,914	549	135	254	50	471
	329	117	47	24	269	148	60	21	3,876	1,460	154	31	177	50	244
	190	137	1,327	349	638	297	33	15	13,717	6,443	103	39	212	59	262
	215	161	140	47	643	236	6	6	1,183	654	13	.....	17	8	.....
	303	235	233	175	7,015	2,785	299	266	7,602	5,337	148	71	373	170	385
	35,467	**26,295**	**23,597**	**16,304**	**63,015**	**43,732**	**14,090**	**9,979**	**478,390**	**352,809**	**19,299**	**13,358**	**48,508**	**29,269**	**35,629**
	74		**69**		**69**		**71**		**74**		**69**		**60**		**75**
	2.7		**1.8**		**4.8**		**1.1**		**36.0**		**1.5**		**3.7**		**2.7**

229	166	12	12	227	170	87	66			61	15	112	
356	254	279	210	959	678	225	144	6,797	4,153	225	141	847	
302	234	151	128	379	355	138	123	2,995	2,214	174	122	348	
25	10	.....	.....	.....	.....	3	.....	75	75	6	6	.....	...
5	5	.....	.....	.....	.....	3	3	.....	.....	.....	.....	.....	...
34	20	.....	.....	99	57	12	3	755	403	25	19	263	
201	108	105	58	620	341	240	162	4,681	3,172	316	193	2,196	1
171	39	.....	.....	193	109	39	15	503	327	19	13	117	
523	371	.....	.....	146	113	54	48	528	428	218	154	42	
191	137	326	279	501	360	24	21	8,432	6,493	419	309	2,891	1
3,582	2,952	745	698	3,586	2,950	1,163	963	29,802	25,623	1,774	1,432	3,841	2
308	219	105	81	578	412	93	75	10,144	8,457	71	45	729	
448	380	780	535	885	530	215	197	13,843	11,226	425	206	2,392	1
327	244	81	35	1,348	984	317	176	2,014	1,736	32	19	399	
10	10	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	...
893	548	745	698	1,477	1,093	239	156	14,424	13,314	626	368	1,585	
1,439	977	198	198	752	506	627	434	5,789	4,455	458	290	1,017	
137	118	23	23	715	573	39	39	5,815	4,859	161	148	356	
265	206	175	151	629	515	141	111	9,943	9,037	154	108	754	
5	5	70	70	14	10	.....	.....	1,032	881	.....	.....	228	
1,046	846	512	466	1,509	1,235	574	415	11,226	9,389	1,676	1,263	1,713	1,
273	220	81	58	774	664	129	102	2,089	1,559	296	142	348	
274	215	105	81	99	89	239	167	957	881	52	45	118	
59	54	23	23	71	71	48	3	1,837	1,636	187	181	695	
10	5	12	12	113	61	21	9	982	881	45	19	297	
29	29	.....	.....	.....	.....	33	12	277	202	.....	.....	.....	...
83	49	12	12	52	38	126	36	1,889	1,485	90	84	203	
245	187	23	12	274	184	60	39	2,567	2,013	83	37	74	
368	348	12	.....	198	169	236	230	3,045	2,819	344	251	127	
74	59	12	.....	90	62	.....	.....	353	328	18	18	8	
5	5	.....	.....	.....	.....	6	3	100	100	.....	.....	.....	...
317	268	1,746	1,467	785	402	90	72	18,048	12,258	374	155	865	
162	83	81	35	364	260	30	12	3,625	1,838	12	6	416	
20	20	.....	.....	19	.....	.....	.....	755	252	.....	.....	823	
,102	840	1,257	966	2,099	1,575	287	200	10,672	6,998	910	774	1,501	
,089	967	3,352	2,340	5,657	4,484	413	332	61,968	48,227	290	225	2,315	1,
49	49	70	47	94	79	3	3	2,617	2,315	32	.....	348	
361	234	245	140	1,850	1,273	177	114	1,360	781	90	44	161	
249	190	698	466	1,746	1,311	63	33	12,258	7,978	84	19	746	
235	215	1,886	617	1,343	709	57	33	8,758	6,696	64	45	788	
542	487	245	221	649	545	252	150	8,710	7,098	296	289	551	
69	64	46	35	217	188	87	75	706	528	19	19	24	
293	230	47	23	360	283	105	96	5,588	4,280	347	257	594	
528	415	337	209	1,504	1,003	156	135	10,068	7,575	258	187	169	
185	113	12	12	123	80	27	15	479	479	39	39	169	
201	176	12	.....	75	57	81	69	2,793	2,341	44	31	76	
141	113	407	303	870	709	105	66	3,776	2,971	45	44	491	
434	450	314	128	2,035	885	424	90	6,971	1,914	549	135	254	
329	117	47	24	269	148	60	21	3,876	1,460	154	31	177	
190	137	1,327	349	638	297	33	15	13,717	6,443	103	39	212	
215	161	140	47	643	236	6	6	1,183	654	13	.....	17	
303	235	233	175	7,015	2,785	299	266	7,602	5,337	148	71	373	
467	**26,295**	**23,597**	**16,304**	**63,015**	**43,732**	**14,090**	**9,979**	**478,390**	**352,809**	**19,299**	**13,358**	**48,508**	**29,2**
74		**69**		**69**		**71**		**74**		**69**		**60**	
2.7		**1.8**		**4.8**		**1.1**		**36.0**		**1.5**		**3.7**	

Supplement to

American Machinist

May 29, 1940

491	768	506	3,062	1,672	573	319	289	187	588	455	342	2
263	104	69	883	662	153	62	41	30	365	244	151	1
.....	.....	.....	432	191	3	.....	11	2	20	.....	.....	.....
.....	.....	.....	240	49	.....	.....	4	.....	.....	.....	14	1
135	.....	.....	99	59	12	6	10	1	202	101	28	.....
1,144	453	261	1,725	1,421	353	121	254	175	2,396	549	669	4
42	.....	.....	274	171	18	6	109	75	.....	.....	28	1
42	384	349	323	251	3	3	18	15	405	385	179	15
1,586	768	489	2,396	1,562	544	338	268	175	507	386	83	6
2,831	4,277	3,859	8,796	6,551	353	198	1,799	1,664	6,942	6,131	6,902	6,23
492	52	52	779	652	409	361	85	1	101	81	164	9
1,535	437	350	1,661	986	1,229	894	384	232	223	203	55	5
279	52	35	676	470	115	115	2	.....	101	81	82	8
.....	.....	.....	.....	.....	.....	.....	6	6	.....	.....	1,558	1,32
780	629	506	1,259	667	80	77	395	305	1,077	872	616	53
721	855	610	1,945	1,215	12	12	175	126	732	589	1,134	86
305	297	279	936	853	47	24	219	207	730	710	697	46
550	209	175	687	564	738	611	616	579	324	324	69	4
152	52	52	132	98	71	39	34	27	.....	.....	.....	.....
1,212	2,374	1,711	6,106	4,528	1,344	1,047	577	453	1,745	1,643	998	84
204	314	209	1,033	568	86	51	360	301	1,299	1,036	355	32
67	139	122	275	118	.....	.....	98	97	406	345	315	23
695	34	17	1,690	1,447	82	50	1,777	1,600	81	61	82	5
186	174	174	123	74	206	139	616	543	.....	.....	55	4
.....	17	.....	30	5	.....	.....	.....	.....	81	60	27	2
135	52	52	363	319	200	59	56	29	101	101	110	11
25	139	87	211	127	15	6	3	3	1,664	1,178	1,162	76
109	1,259	1,187	1,617	1,323	47	9	325	320	1,300	1,239	1,407	1,39
8	104	87	166	132	3	3	5	5	326	284	164	15
.....	.....	.....	20	20	.....	.....	1	1	121	121	14	1
560	558	454	956	754	545	438	208	153	1,604	1,299	410	32
160	314	140	740	529	92	41	2	1	244	102	151	5
611	.....	.....	515	427	6	.....	1	.....	41	41	.....	.....
907	891	734	1,892	1,603	274	168	341	254	792	426	437	39
1,578	646	489	1,211	1,004	1,476	926	882	653	4,223	3,695	821	67
170	17	17	251	217	38	38	5	4	345	305	68	6
59	157	139	197	83	9	6	86	43	811	671	1,804	1,65
424	244	52	382	334	263	109	177	130	832	670	1,039	95
271	226	139	197	148	611	379	65	52	1,788	1,565	548	49
414	908	803	991	760	121	89	320	278	2,376	2,031	2,064	1,79
24	122	105	245	211	18	18	169	150	305	305	301	28
398	279	244	264	158	48	45	.....	.....	732	548	670	45
92	209	139	339	245	100	65	47	28	3,492	2,944	2,638	2,39
85	87	87	785	662	6	3	130	95	81	20	14	1
51	157	157	387	309	136	12	29	24	1,076	995	1,394	1,25
287	140	35	377	266	303	192	29	14	629	487	68	6
50	471	121	436	186	48	12	23	4	10,492	2,335	3,323	1,28
50	244	51	211	65	42	27	9	1	2,334	427	547	4
59	262	87	89	55	191	136	5	.....	610	304	96	6
8	.....	.....	54	35	3	.....	2	1	324	203	110	6
170	385	315	2,964	2,442	1,917	1,305	616	470	2,599	1,422	984	90
29,269	**35,629**	**26,741**	**78,218**	**55,676**	**17,795**	**11,859**	**15,803**	**12,757**	**97,363**	**68,133**	**62,295**	**50,780**
	75		**71**		**67**		**81**		**70**		**82**	
	2.7		**5.9**		**1.3**		**1.2**		**7.4**		**4.7**	

573	319	289	187	588	455	342	261	2,086	1,107	740	467	**21,468**	**13,346**	**62**
153	62	41	30	365	244	151	138	491	290	97	79	**8,149**	**5,892**	**72**
3	.....	11	2	20	.....	.....	.....	54	.....	.....	.....	**767**	**335**	**41**
.....	.....	4	.....	.....	.....	14	14	73	.....	9	9	**461**	**90**	**17**
12	6	10	1	202	101	28	.....	73	73	44	18	**3,105**	**1,818**	**58**
353	121	254	175	2,396	549	669	438	980	654	18	18	**17,291**	**10,206**	**59**
18	6	109	75	.....	.....	28	14	180	36	71	18	**2,413**	**1,010**	**41**
3	3	18	15	405	385	179	151	507	399	79	79	**3,999**	**3,307**	**83**
544	338	268	175	507	386	83	69	1,034	617	723	353	**21,798**	**15,226**	**69**
353	198	1,799	1,664	6,942	6,131	6,902	6,232	6,916	5,589	1,348	978	**95,003**	**79,136**	**83**
409	361	85	1	101	81	164	96	54	54	203	132	**19,099**	**14,464**	**75**
1,229	894	384	232	223	203	55	55	454	417	494	370	**29,674**	**21,481**	**72**
115	115	2	.....	101	81	82	82	145	127	.....	.....	**7,093**	**5,488**	**77**
.....	.....	6	6	.....	.....	1,558	1,326	18	18	.....	.....	**1,612**	**1,380**	**86**
80	77	395	305	1,077	872	616	535	1,017	670	255	159	**28,010**	**22,909**	**81**
12	12	175	126	732	589	1,134	861	1,107	944	238	194	**19,898**	**14,654**	**73**
47	24	219	207	730	710	697	465	471	272	185	159	**13,048**	**10,468**	**80**
738	611	616	579	324	324	69	42	671	344	238	212	**17,852**	**15,365**	**86**
71	39	34	27	.....	.....	.....	.....	127	109	88	70	**2,270**	**1,907**	**84**
1,344	1,047	577	453	1,745	1,643	998	847	2,830	2,251	2,397	1,876	**41,544**	**33,340**	**80**
86	51	360	301	1,299	1,036	355	327	943	727	150	97	**10,326**	**7,449**	**71**
.....	.....	98	97	406	345	315	233	236	236	115	70	**4,283**	**3,359**	**78**
82	50	1,777	1,600	81	61	82	54	18	18	149	114	**7,272**	**6,329**	**87**
206	139	616	543	.....	.....	55	41	163	127	176	176	**3,347**	**2,671**	**79**
.....	.....	.....	.....	81	60	27	27	36	18	141	115	**1,539**	**877**	**57**
200	59	56	29	101	101	110	110	345	327	476	476	**5,680**	**4,447**	**78**
15	6	3	3	1,664	1,178	1,162	767	308	308	176	141	**7,807**	**5,646**	**72**
47	9	325	320	1,300	1,239	1,407	1,394	1,542	1,379	300	238	**13,277**	**12,054**	**91**
3	3	5	5	326	284	164	150	163	145	9	.....	**1,671**	**1,419**	**85**
.....	.....	1	1	121	121	14	14	18	.....	.....	.....	**300**	**279**	**93**
545	438	208	153	1,604	1,299	410	328	852	545	669	529	**31,509**	**21,324**	**67**
92	41	2	1	244	102	151	55	235	163	149	36	**7,347**	**3,697**	**50**
6	.....	1	.....	41	41	.....	.....	.....	.....	62	.....	**3,144**	**1,477**	**47**
274	168	341	254	792	426	437	397	1,289	1,143	1,947	1,630	**31,500**	**22,733**	**72**
1,476	926	882	653	4,223	3,695	821	670	2,559	1,778	1,533	1,286	**114,295**	**87,558**	**77**
38	38	5	4	345	305	68	68	72	54	35	27	**5,229**	**4,185**	**80**
9	6	86	43	811	671	1,804	1,653	380	199	45	36	**9,670**	**6,151**	**63**
263	109	177	130	832	670	1,039	957	235	199	3,648	3,595	**24,939**	**18,242**	**75**
611	379	65	52	1,788	1,565	548	493	254	54	176	44	**21,855**	**13,613**	**62**
121	89	320	278	2,376	2,031	2,064	1,790	2,741	2,015	397	326	**24,001**	**19,544**	**81**
18	18	169	150	305	305	301	287	380	308	62	44	**3,368**	**2,770**	**85**
48	45	.....	.....	732	548	670	451	744	635	202	149	**11,361**	**8,535**	**75**
100	65	47	28	3,492	2,944	2,638	2,393	399	235	97	71	**23,012**	**17,581**	**76**
6	3	130	95	81	20	14	14	127	127	96	62	**2,968**	**2,226**	**74**
136	12	29	24	1,076	995	1,394	1,258	162	126	18	18	**7,778**	**6,433**	**83**
303	192	29	14	629	487	68	68	163	72	123	80	**9,950**	**7,392**	**74**
48	12	23	4	10,492	2,335	3,323	1,285	1,231	381	141	9	**34,686**	**9,408**	**27**
42	27	9	1	2,334	427	547	41	690	273	88	18	**10,504**	**3,040**	**28**
191	136	5	.....	610	304	96	69	272	36	71	18	**26,296**	**11,941**	**45**
3	.....	2	1	324	203	110	68	.....	.....	.....	.....	**4,414**	**1,797**	**41**
1,917	1,305	616	470	2,599	1,422	984	902	708	290	52	26	**39,964**	**23,042**	**58**
17,795	**11,859**	**15,803**	**12,757**	**97,363**	**68,133**	**62,295**	**50,780**	**59,200**	**41,974**	**27,002**	**20,503**	**1,323,131**	**933,158**	
	67		**81**		**70**		**82**		**71**		**76**	**Over-all Percentage**		**70**
	1.3		**1.2**		**7.4**		**4.7**		**4.5**		**2.0**			